B.C.Hydro

Electric Load Forecast

1987/88 - 2007/08

Low-Probable-High

Prepared by
Load Forecast Department
Corporate Affairs

1987

British Columbia Cataloguing in Publication Data

Main entry under title:
Electric and gas load forecasts. -- 1987/88 - 2007/08

Continues: Projections of gross load requirements.
ISSN 0715-2345
ISSN 0835-5991

1. Energy consumption - British Columbia - Periodicals. 2. Electric power - British Columbia - Periodicals. 3. Gas, Natural - British Columbia - Periodicals. 4. B. C. Hydro - Periodicals. I. B. C. Hydro. Load Forecast Dept. Corporate Affairs.

HD9502.C33B76 333.79'12'09711

LOAD FORECAST

CONTENTS

Section	Subject	Page
	SUMMARY	iv
1.0	INTRODUCTION	1 - 1
2.0	ECONOMIC FORECASTS	2 - 1
	2.1 Source of Projections	2 - 1
	2.2 Probable Economic Growth	2 - 1
	2.3 Population Forecast	2 - 2
	2.4 Sectoral Outlooks	2 - 2
	2.5 Energy Prices	2 - 5
	2.6 Alternative Economic Scenarios	2 - 8
3.0	PROBABLE ELECTRIC FORECAST	3 - 1
	3.1 Residential Sales	3 - 1
	3.2 Commercial Sector	3 - 5
	3.3 Industrial Sector	3 - 7
	3.4 Other Sales	3 - 12
	3.5 Gross Requirements	3 - 12
4.0	ELECTRIC FORECAST UNCERTAINTY	4 - 1
	4.1 Probable Forecast Sensitivities	4 - 1
	4.2 Probability Distribution Around Probable Forecast	4 - 4
	4.3 High and Low Scenarios	4 - 9
	4.4 Comparison of Historical Forecasts	4 - 12
5.0	MARKETING AND DEMAND SIDE MANAGEMENT	5 - 1
	5.1 Industrial Marketing Programs	5 - 1
	5.2 Interruptible Marketing Programs (Electric Plus)	5 - 3
	5.3 Demand Side Management Programs	5 - 4

CONTENTS - (Cont'd)

APPENDICES

Appendix No.		Page
A	FORECAST METHODOLOGY	
	A.1 Methodology	A - 1
	A.2 Inputs to the Forecast	A - 3
B	RATE CATEGORIES	B - 1
C	USE OF FORECASTS IN SYSTEM PLANNING	C - 1
	C.1 Distribution Substation Forecasts	C - 1
	C.2 Customers Served at Transmission Voltages	C - 3
	C.3 System Peak Forecast	C - 3

TABLES

Table No.		Page
1	B.C. Hydro Probable Gross Load Requirements by Major Sectors	vii
2	Comparison of 1987 and 1986 Probable Forecasts to 1997/98 and 2007/08	vi
3	Electric Gross Load Requirements - Integrated System for 1997/98 and 2007/08	viii
1-1	Domestic Service Area Growth: 1986/87 over 1985/86	1 - 2
2-1	B.C. Sectoral GDP Growth	2 - 3
3-1	B.C. Hydro Electric Billed Sales and Gross Requirements - 1997/98	3 - 2
3-2	Residential Electric Sales Forecast	3 - 4
3-3	Commercial Electric Sales Forecast	3 - 6
3-4	Industrial Sales - Percent Share by SIC Sector	3 - 7
3-5	Industrial Electric Sales Forecast	3 - 11
4-1	Impacts of Strikes/Lockouts	4 - 2

CONTENTS - (Cont'd)

TABLES - (Cont'd)

Table No.		Page
4-2	Weather Impact on Sales	4 - 2
4-3	Forecast Sensitivities - 1997/98	4 - 4
4-4	Mean and Standard Deviation	4 - 9
4-5	Scenarios, Low - Probable - High	4 - 10
4-6	Electric Gross Load Requirements Forecast - Integrated System	4 - 11
4-7	Percent Error - Years After Forecast	4 - 12
5-1	Firm Industrial Marketing Programs	5 - 2
B-1	B.C. Hydro Historical and Probable Electric Sales Forecast by Rate Categories	B - 2

ILLUSTRATIONS

Figure No.		Page
1	B.C. Hydro - Electric Gross Requirements	v
2	B.C. Hydro Electric Gross Load Requirements Forecast - Scenarios - Integrated System	ix
2-1	Residential Heating Price Forecast	2 - 7
4-1	Probability Density of Total Sales - 1991	4 - 7
4-2	Total Sales Bandwidth	4 - 8
4-3	Gross Electric Requirements - Comparison of Actual with Forecast Made in 1962 Through 1987	4 - 13
A-1	Residential Forecast Flow Chart	A - 5
A-2	Commercial Forecast Flow Chart	A - 6
C-1	Forecast Use in System Planning	C - 2

SUMMARY

The B.C. economy is forecast to average 2.9 percent real annual growth over the period to 1997 and 2.8 percent in the following 10-year period to 2007. The main growth areas through 1997 are projected to be paper and allied manufacturing, non-resource based manufacturing, construction, and community, business and personal services.

Economic growth is forecast to be marginally lower than was projected last year. The paper and allied products sector projections are higher but this is offset by lower projections for mining. Non-resource based manufacturing and the community, business and personal services sectors are also lower than last year even though they remain as primary growth areas.

Population growth in the 1.3 percent to 1.4 percent range on an annual average basis is expected through the 20-year period. This is reduced from last year's forecast generally in line with the reduced GDP forecast.

In this year's forecast, electricity prices are assumed to be held flat in nominal terms through 1994, (a further 4 years compared to last year's forecast) and increase at the rate of inflation thereafter. Assuming an inflation rate of 4.5 percent/yr this equates to a further reduction in real electricity prices of nearly 15 percent compared to last year's forecast.

Electric energy requirements, in the probable case, are projected to increase from 38 306 GW.h in 1986/87 to 51 510 GW.h in 1997/98 and to 68 260 GW.h in 2007/08 for an annual average growth rate of 2.8 percent. Table 1 details the projections by forecast sectors. Figure 1 shows historical and projected gross requirements and growth rates.

Growth in sales to 1997/98 is projected at a net 11 300 GW.h. Growth by major sector shows residential with 2850 GW.h, commercial with 3700 GW.h and industrial with a net of 4600 GW.h. Within the industrial area the paper and allied products sector is projected to grow by 3150 GW.h but the metal mining sector to decrease by 1000 GW.h with closures of existing copper mines.

This year's sales forecast is marginally higher (1400 GW.h) for 1997/98 than last year's. The significant changes are:

- A major increase in sales to the paper and allied products sector (2100 GW.h). Several expansions and new projects have been committed and generally all involve the addition of electric intensive mechanical pulping.

- A significant decrease in sales to the metal mining sector (1000 GW.h). Existing mines are now expected to close earlier.

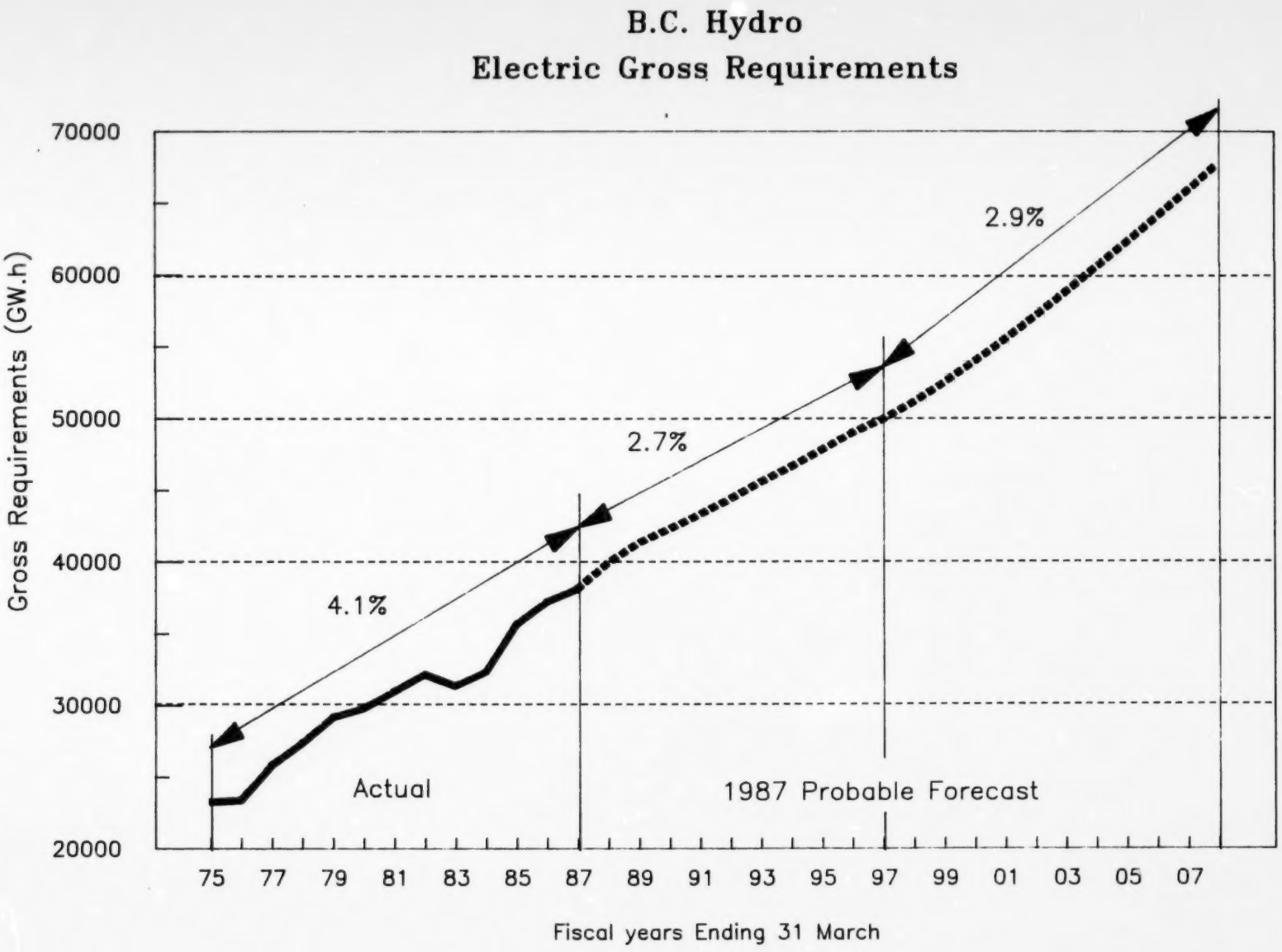
B.C. Hydro
Electric Gross Requirements
Gross Requirements (GW.h)
70000
60000
50000
40000
30000
20000
4.1%
2.7%
2.9%
Actual
1987 Probable Forecast
75
77
79
81
83
85
87
89
91
93
95
97
99
01
03
05
07
Fiscal years Ending 31 March

Figure 1

- Higher residential and commercial sales (total of 800 GW.h). Lower population projections (and thus accounts) more than offset by lower projected electricity prices which lead to less conservation and thus higher use per account.

The anomaly, in this year's forecast, of lower economic projections and yet higher electricity sales is due primarily to two factors. The higher growth projected this year in the paper and allied products sector is very electric intensive and the lower electricity prices seen this year lead to less projected conservation and thus greater electricity intensity in all areas.

Table 2 shows the major assumptions and probable forecast compared to last year's projections.

TABLE 2

COMPARISON OF 1987 AND 1986 PROBABLE FORECASTS
TO 1997/98 AND 2007/08

	Forecast Period	
	1987	1986
Economic Assumptions		
B.C. Gross Domestic Product (GDP) Growth Rate (%/yr)		
1986 to 1997	2.9	3.2
1997 to 2007	2.8	3.0
Population Growth Rate (%/yr)		
1986 to 1997	1.26	1.35
1997 to 2007	1.42	1.60
Electricity Prices-Real Decline, 1986 to 1995	31%	17%
Electric Forecast - Probable		
Gross Requirements 1997/98 (GW.h)	51 510	49 850
Average Annual Growth Rate (%/yr) 1986/87 to 1997/98	2.7	2.4
Gross Requirements 2007/08 (GW.h)	68 260	64 450
Average Annual Growth Rate (%/yr) 1997/98 to 2007/08	2.9	2.6
Net Change in Forecast-Advancement (years)		
- by 1997/98	1	-
- by 2007/08	2	-

Table 1

B.C. HYDRO PROBABLE GROSS LOAD REQUIREMENTS BY MAJOR SECTORS
(Including SCL & WKP&L)

Fiscal Year	Residential (GW.h)	Commercial (GW.h)	Industrial (GW.h)	Other (GW.h) (1)	Total Sales (GW.h) (2)	Losses/ Accruals (GW.h)	TOTAL GROSS REQT'S. (GW.h)	LESS Non-Integr. (GW.h)	<- Integrated -> System GROSS REQT'S. (GW.h)	PEAK (MW)
Actual										
1985/86	9,793	8,315	14,577	452	33,137	4,290	37,427	166	37,261	6,816
1986/87	9,666	8,678	15,348	622	34,314	3,992	38,306	167	38,139	6,467
Forecast										
1987/88	10,105	8,962	15,791	679	35,537	4,593	40,130	170	39,960	7,090
1988/89	10,314	9,206	16,592	668	36,779	4,731	41,510	180	41,330	7,300
1989/90	10,531	9,450	17,026	636	37,643	4,837	42,480	180	42,300	7,410
1990/91	10,751	9,715	17,406	648	38,519	4,961	43,480	190	43,290	7,590
1991/92	10,976	10,014	17,804	661	39,455	5,095	44,550	200	44,350	7,790
1992/93	11,215	10,347	18,254	674	40,490	5,230	45,720	200	45,520	8,010
1993/94	11,459	10,709	18,572	689	41,428	5,352	46,780	210	46,570	8,200
1994/95	11,722	11,092	18,936	705	42,455	5,495	47,950	210	47,740	8,410
1995/96	11,994	11,492	19,286	724	43,496	5,644	49,140	220	48,920	8,630
1996/97	12,263	11,914	19,591	744	44,513	5,787	50,300	230	50,070	8,850
1997/98	12,522	12,352	19,940	764	45,578	5,932	51,510	230	51,280	9,080
Avg. Annual Growth: %										
11 years:										
86/87-97/98	2.4%	3.3%	2.4%	1.9%	2.6%	3.7%	2.7%	3.0%	2.7%	3.1%
1998/99	12,782	12,812	20,457	739	46,790	6,090	52,880	240	52,640	9,320
1999/2000	13,044	13,294	20,995	780	48,113	6,267	54,380	260	54,120	9,580
2000/01	13,309	13,804	21,533	820	49,465	6,445	55,910	270	55,640	9,840
2001/02	13,578	14,337	22,097	917	50,929	6,631	57,560	270	57,290	10,130
2002/03	13,852	14,897	22,663	1,002	52,414	6,826	59,240	280	58,960	10,420
2003/04	14,132	15,487	23,221	1,092	53,932	7,038	60,970	290	60,680	10,720
2004/05	14,420	16,108	23,780	1,164	55,472	7,238	62,710	300	62,410	11,020
2005/06	14,718	16,756	24,341	1,255	57,070	7,460	64,530	310	64,220	11,330
2006/07	15,028	17,425	24,901	1,340	58,694	7,666	66,360	310	66,050	11,650
2007/08	15,352	18,122	25,462	1,422	60,359	7,901	68,260	330	67,930	11,990
Avg. Annual Growth: %										
10 years:										
97/98-07/08	2.1%	3.9%	2.5%	6.4%	2.8%	2.9%	2.9%	3.7%	2.9%	2.8%
21 years:										
86/87-07/08	2.2%	3.6%	2.4%	4.0%	2.7%	3.3%	2.8%	3.3%	2.8%	3.0%

Notes:

1 Inter-Utility transfers (including WKP & L) and firm export (including SCL).
2 Interruptible Marketing (E+) and Demand Side Management (DSM) programs not included.

A range of forecasts has been prepared around the probable forecast:

- An 80 percent probability band has been developed around the probable forecast. This band reflects the uncertainty inherent in the forecast even if the economic projections (GDP and population) do occur.

- Two different economic scenarios, i.e. possible development paths for B.C. that are markedly different from the probable economic forecast, have been developed. Attaching electricity sales to the scenarios (assuming similar electric intensity to the probable forecast) provides Low and High gross energy forecasts.

Gross requirements for the various forecasts for the integrated system (including SCL and WKP&L) are tabulated in Table 3 and shown graphically in Fig. 2.

TABLE 3

ELECTRIC GROSS LOAD REQUIREMENTS
INTEGRATED SYSTEM (INCLUDING SCL & WKP&L)
(GW.h)

		Range of Probable Forecasts			
	Low Scenario	Probable Low	Probable	Probable High	High Scenario
1997/98	44 140	47 850	51 280	54 710	59 470
Average Annual Growth (%/yr) 1986/87 to 1997/98	1.3	2.1	2.7	3.3	4.1
2007/08	55 790	60 830	67 930	75 230	85 410
Average Annual Growth (%/yr) 1997/98 to 2007/08	2.4	2.4	2.9	3.2	3.7
Average Annual Growth (%/yr) 1986/87 to 2007/08	1.8	2.2	2.8	3.3	3.9

B.C. HYDRO ELECTRIC GROSS LOAD REQUIREMENTS FORECAST – SCENARIOS

INTEGRATED SYSTEM (Including SCL and WKP&L)

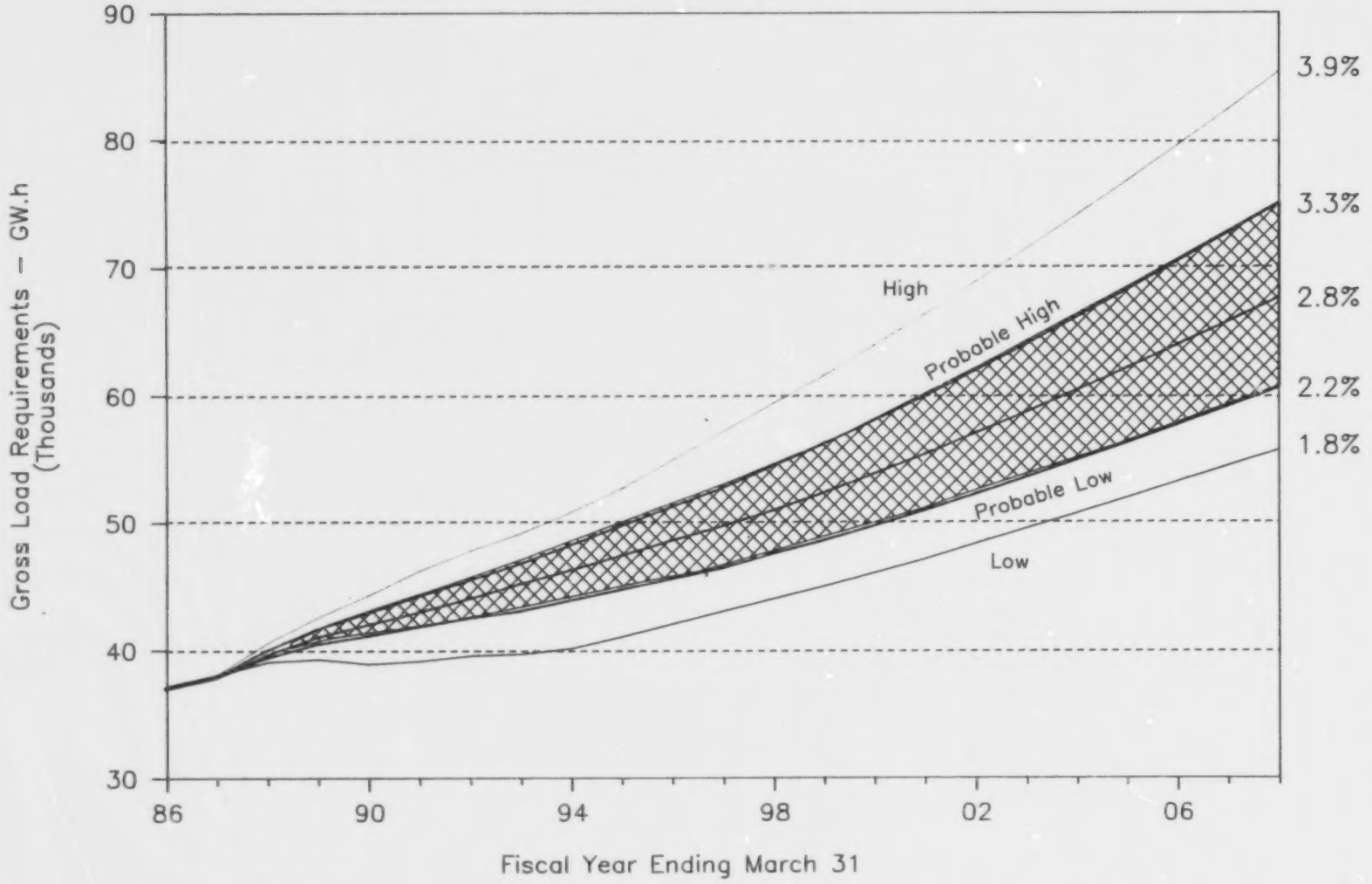

FIGURE 2

SECTION 1.0 - INTRODUCTION

This document presents B.C. Hydro's 1987 forecasts of gross electric requirements through 2007/08.

The economic and energy price assumptions that drive the electric forecasts are provided in Section 2.0.

The probable (most likely) electric forecast is built up from sales projections of the key sectors, i.e. residential, commercial, industrial and other. The projections are done in detail for the first 10 years (through 1997/98) with year-over-year forecasts for the various categories and major customers. This allows for financial planning and detailed distribution and transmission planning to be carried out. The second 10 years is based on economic trend projections and is mainly used for generation planning which does not require the same level of detail. Discussion of the probable electric forecast, Section 3.0, is focused on the detailed period of the forecast (i.e. through 1997/98).

Because the future is inherently uncertain, load growth is a random variable with an expected value (the probable) and a variance or error term. It is necessary in planning to pay at least as much attention to the uncertainty in the forecast as it is to the probable outcome itself. A range of forecasts has thus been prepared around the probable forecast. This question of uncertainty is dealt with in Section 4.0.

Marketing and Demand Side Management (DSM) programs will have increasing effect on actual load growth and load shape in the B.C. Hydro system. The new Interruptible marketing and DSM programs are not factored directly into the 1987 forecasts, but they must be considered in system planning. Section 5.0 discusses the present status of the programs and their impact on load growth.

Details on forecast methodology are provided in Appendix A. For revenue calculations and distribution planning, the probable forecast must be provided by rate categories; these are given in Appendix B. Appendix C shows how the forecast is used in system planning and how consistency between the various uses is maintained.

As a perspective on how (from an electricity viewpoint) B.C. Hydro fits into the energy picture in B.C. and what current growth trends are, the following statistics are provided.

Total energy use (on an end use basis) in B.C. in 1985 was approximately 840 petajoules*[1]. Of this, approximately 154 petajoules was electricity

---

*1 1 petajoule = 278 GW.h.

(encompassing both purchased and self-generated). B.C. Hydro supplied 118 petajoules. Thus B.C. Hydro supplied nearly 77 percent of the electricity and 14 percent of the total energy used in B.C. in 1985.

Growth on the B.C. Hydro domestic system over the last year is tabulated in Table 1-1. The domestic system excludes sales to West Kootenay Power and Light, Seattle City Light and export surplus, but includes domestic non-integrated areas (Zone II diesel districts).

TABLE 1-1

DOMESTIC SERVICE AREA GROWTH: 1986/87 OVER 1985/86

	Actual 1985/86	Growth (Decrease)	Actual 1986/87	% Growth (Decline)
Total Domestic Sales	32 960 GW.h	1 018 GW.h	33 978 GW.h	3.1
Gross Requirements	37 252 GW.h	718 GW.h	37 970 GW.h	1.9
Peak Demand	6 750 MW	(372 MW)	6 378 MW	(5.5)
Weather Normalized Peak	6 565 MW	150 MW	6 715 MW	2.3

The lower growth in gross requirements (1.9%) compared to sales (3.1%) was due to an (apparent) marked decrease in losses. Actual growth in peak demand was negative due to a winter without a prolonged cold spell, whereas in the previous year an abnormal cold spell occurred.

Growth in total domestic sales is projected to continue in the 3 to 4 percent (annual) range over the next 3 years. Added load in the pulp and paper sector will be the main source of new load.

SECTION 2.0 - ECONOMIC FORECASTS

This section describes the major assumptions underlying the probable electric sales forecasts: economic growth, population, commercial and industrial sector outlooks and energy prices. Alternative economic growth scenarios are also presented.

2.1 SOURCE OF PROJECTIONS

The overall provincial economic growth and population projections were based on the latest (1987) long-term planning scenario of the B.C. Ministry of Economic Development.

Additional consultant input was obtained for some of the electricity intensive sectors. H.N. Halvorson Consultants Ltd. prepared an outlook for metal mining, coal mining and smelting industries and a projection for B.C. through the year 2000. Widman Management Limited prepared a 10-year projection for B.C.'s pulp and paper industry and a brief analysis of the impact of the softwood lumber export tax.

Electricity price projections were based on internal analysis of revenue requirements and financial performance. Natural gas and crude oil price projections were based on input from Confer Consulting Ltd.

2.2 PROBABLE ECONOMIC GROWTH

The probable economic forecast is based on an assumption of steady, moderate growth for the major western countries. U.S. policy is assumed to maintain a low inflation rate, achieve steady trade and budget deficit reductions and achieve exchange and interest rate stability. World economic activity is expected to be strong enough to absorb U.S. economic policy adjustments without sliding into a recession. Japan and West Germany are assumed to be able to adapt to the large appreciation of their currencies but do not implement reflationary policies that would allow for robust economic growth. Economic growth in Canada will remain dependent on world conditions and will be equal to or marginally higher than U.S. growth.

Overall, B.C. economic growth (GDP) is expected to average close to the Canadian long-term projections. Through 1997 GDP is forecast to grow at an annual average of 2.9 percent. For the following 10 years through 2007, growth is projected at 2.8 percent.

Long-term economic growth in B.C. will be determined largely by increases in productivity and the continued strong performance of the

export sector. Favourable exchange rates, increased productivity, relatively slower wage inflation and movement towards freer trade will contribute positively to the export sector as will our locational advantage on the expanding Pacific Rim market.

2.3 POPULATION FORECAST

The natural component (births minus deaths) of B.C.'s population growth has displayed only slow variation over time. Net migration from inter-provincial and international sources has, however, oscillated significantly around an annual level of 25,000. The volume of international immigration is largely determined by federal government policy. Inter-provincial migration is influenced by unemployment levels in B.C. relative to other areas in Canada.

With a slowly improving unemployment rate for B.C., inter-provincial migration into B.C. is expected to increase gradually from the near zero level of the last few years to 18,000 in 1997 and to 28,000 in 2007. International immigration into B.C. is projected to gradually increase over the forecast period from the present 5,000 annual level to 14,500 in 1997 and then remain relatively constant at that number.

The resultant population for B.C. is forecast to rise from 2,900,000 in 1986 at an average annual rate of 1.26 percent to 3,328,000 in 1997 and then at an average annual rate of 1.42 percent to 3,831,000 in 2007.

2.4 SECTORAL OUTLOOKS

The commercial (service producing) sector accounted for nearly 73 percent of provincial GDP in 1986 with the industrial (goods producing) sector accounting for 27 percent. The commercial sector is expected to continue to grow marginally faster than the industrial sector through the forecast period.

The resource-based industrial sectors, forestry and mining, and their related manufacturing activities will continue to constitute a major portion of B.C.'s economic output. They will be supplanted, however, as drivers of B.C. economic growth by new or expanding sectors such as non-resource based manufacturing, transportation and communications and community, business and personal services. Refer to Table 2-1.

Within metal mining, the last few years has seen weak demand and depressed prices for copper, molybdenum and most other non-precious metals. With limited growth in requirements and supply pressures from new mines in developing countries, growth in production and increases in prices are expected to remain constrained over the long term. Gold and silver will continue to enjoy good markets and provide positive growth to the sector. Long-term sectoral growth, however, is projected to average considerably lower than for total GDP.

TABLE 2-1

B.C. SECTORAL GDP GROWTH

	1986 Share of Economy (%)	Projected Real Average Annual Percent Growth	
		1986 to 1997	1997 to 2007
Industrial or Goods Producing			
Agriculture	1.4	2.4	2.1
Fishing & Trapping	0.4	2.4	0.0
Primary Forest	2.5	2.1	0.1
Mining - Metal	0.8	1.0	2.3
Mining - Coal	1.3	1.8	2.4
Mining - Remainder	0.5	1.9	1.7
Manufacturing - Wood	4.2	2.0	0.5
Manufacturing - Paper and Allied Products	2.8	3.4	2.0
Manufacturing - Chemicals and Chemical Products	0.4	2.8	2.0
Manufacturing - Remainder	6.7	3.1	2.9
Construction	6.2	3.8	2.9
Total Goods Producing	27.2	2.8	2.1
Commercial or Service Producing			
Finance, Insurance and Real Estate (F.I.R.E.)	16.7	3.0	2.8
Trade	13.0	2.9	2.7
Transportation, Storage and Communication	12.9	3.0	3.1
Utilities	4.1	2.6	2.5
Services	19.9	3.2	3.9
Public Administration	6.2	1.5	2.0
Total Service Producing	72.8	2.9	3.1
Total Real GDP		2.9	2.8

The world outlook for metallurgical (coking) coal is for a long period of stagnating demand and low prices. With the large over-capacity of this type of coal in the world, the outlook for B.C. production over the next few years is flat at best. No new mine development is expected in B.C. for at least a decade. The outlook for thermal coal is better with world consumption continuing to increase. A considerable over-capacity, however, presently exists and prices are low. Some new capacity in the form of small, high quality mines in B.C. is expected in the 1990s as the supply/demand balance comes more in line.

Wood products will remain B.C.'s most important manufacturing industry over the forecast period although it's relative importance will gradually diminish. In the short term the softwood lumber export tax will have a negative effect while in the longer term declining availability of timber will limit growth. Better utilization of raw material plus increased production of higher valued products will provide steady long-term growth.

The pulp and paper industry continues to operate at near capacity with increasing product prices. The result has been the announcement of several new, modernization and capacity addition projects. The long-term outlook is positive as well. Technological advances in mechanical pulping are allowing for use of more of the existing raw material and for different wood species. The trend is expected to continue. There is also a trend to higher value paper products which adds to growth. Long-term growth is thus expected to be considerably higher than for wood manufacturing but eventually fall below overall GDP growth as resource constraints become the limiting factor.

The primary metals sector including the smelting industry is expected to show a healthy long-term growth. Potential exists for additional aluminum and lead/zinc capacity. Possible new smelting additions are in copper, ferrosilicon, magnesium and silicon.

The petroleum products sector is expected to show limited growth. The existing refineries in the Lower Mainland are small by present industry standards and relatively inefficient. Only one may survive.

The chemical industry exists primarily to serve the B.C. chemical pulp industry. As most new pulp capacity is expected to be mechanical, requiring few chemicals, there will be limited increased demand from this sector. However, good potential exists for developing export markets for certain chemicals. The electric-intensive chemical industry is seen to have a distinct advantage in B.C. with our relatively low projected longer term electricity prices.

Non-resource-based manufacturing is projected to be the industrial sector with the most rapid growth throughout the forecast period averaging well above total GDP. The main source of growth is expected to come from diversification into high technology industries.

Construction is expected to grow slightly faster than total GDP over the forecast period. Non-residential construction is projected to increase with the stable economic climate and increased business investment.

Within the commercial sector, community, business and personal services is projected to have the highest long-term growth rate and in fact the highest growth rate of all sectors. Tourism along with personal and business services are expected to be the main growth areas within this sector.

The transportation, storage and communications sector is also expected to grow faster than total GDP with the increased importance external trade is expected to play in B.C.'s economy.

2.5 ENERGY PRICES

The electricity price forecast is based on projected future revenue requirements. Revenue requirements depend on both the costs for existing plant and the costs for additional plant needed to meet load growth as well as other factors such as taxes, export revenues from surplus sales and the costs of servicing U.S. dollar denominated debt. It is difficult to project precise rates and possible changes in rate structure but for forecast purposes it is only necessary to project changes in overall revenue requirements or rate levels.

This year's projection for electricity prices is for constant nominal prices through 1994/95 and constant real thereafter. The result is a real price decline by the mid 1990s of approximately 30 percent (assuming inflation in the 4 to 5 percent range).

The perspective for crude oil prices in the long term remains one of uncertainty and potential volatility. Equilibrium levels of long-term crude oil prices are projected to fall between U.S. $15 and $20 per barrel (1987$). The potential volatility, however, could see swings from U.S. $10 per barrel to U.S. $30 per barrel (1987$). The assumptions are market based and have the following considerations:

- at crude oil prices in excess of U.S. $20 per barrel (1987$), oil demand will increase modestly and non-OPEC supply will be maintained or increased from present levels. This will cause downward price pressure because demand for OPEC crude oil will remain well below desired production levels and market share,

- at crude oil prices below U.S. $15 per barrel (1987$), oil demand will increase and non-OPEC supply will decrease from present levels. This will cause upward price pressure because demand for OPEC crude oil will increase and push against present production capacity, and

- at crude oil prices between U.S. $15 and $20 per barrel (1987$), market forces would be near equilibrium with many alternative fuels. Demand for crude oil would grow with energy market trends, non-OPEC crude oil supply would remain relatively stable and OPEC production would increase but remain significantly below productive capacity.

The natural gas industry is expected to remain in flux in the short term as deregulation initiatives and conflicting policies are sorted out. Prices will be a function of both market forces and the negotiation and resolution of industry constraints. In the longer term, a more stable operating environment will provide for natural gas prices which reflect market and contract terms. Portfolio supply procurement policies will allow multiple natural gas supply arrangements. Prices will vary by key terms such as security of supply and load factor but overall are expected to remain in the range projected for crude oil prices.

At crude oil prices of U.S. $15 per barrel (1987$), natural gas will be under considerable market pressure from crude oil products. Portfolio gas supply costs will have to be as low as Cdn. $2.60 per GJ to maintain market share among large fuel users. Small natural gas consumers will have to pay near equivalent to oil prices to ensure new long-term reserve based gas supply.

Given the high costs of infrastructure systems for natural gas processing and transportation, the market prices for natural gas at crude oil prices of U.S. $15 per barrel (1987$) cause marginally profitable gas prices at the producer level. Suitable fiscal regimes and tight cost control of production and infrastructure activities are required to ensure adequate long-term gas supplies at competitive prices.

At crude oil prices of U.S. $20 per barrel (1987$), natural gas is under less competitive pressure from crude oil products. However, natural gas prices will promote exploration and supply increases to this level of crude oil product prices. The limit on increased gas prices under the U.S. $20 per barrel case is thus the price of other fuels (such as coal) and gas-to-gas competition.

The long-term effect of the outlook for electricity, crude oil and natural gas prices is illustrated for the residential sector in Fig. 2-1. The graph shows efficiency adjusted costs for residential heating fuels with present Lower Mainland prices used. Light fuel oil and natural gas are expected to remain close to the same relative position. Electricity, however, will become relatively cheaper but not to the point of being competitive with natural gas. Thus no significant change in the pattern of fuel use is projected. This same outlook is assumed for the competitive areas within the commercial and industrial sectors.

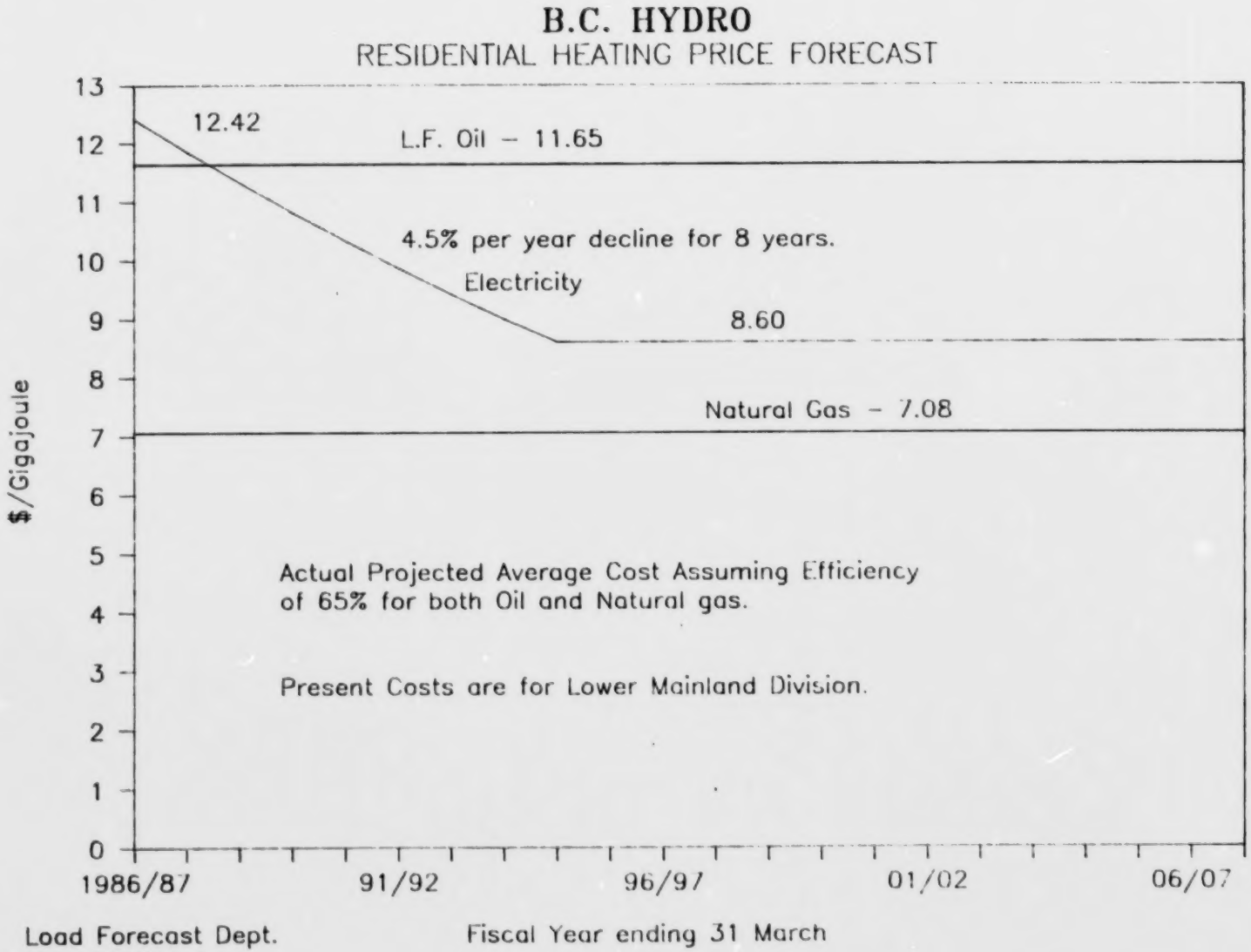
B.C. HYDRO
RESIDENTIAL HEATING PRICE FORECAST
13
12
11
10
9
8
7
6
5
4
3
2
1
0
$/Gigajoule
12.42
L.F. Oil – 11.65
4.5% per year decline for 8 years.
Electricity
8.60
Natural Gas – 7.08
Actual Projected Average Cost Assuming Efficiency
of 65% for both Oil and Natural gas.
Present Costs are for Lower Mainland Division.
1986/87
91/92
96/97
01/02
06/07
Load Forecast Dept.
Jan. 1988
Fiscal Year ending 31 March

Figure 2-1

2.6 ALTERNATIVE ECONOMIC SCENARIOS

The probable economic forecast assumes a slow, steady growth for the major western countries with no major recessions and no reflationary policy changes that could cause rapid growth escalation. While this outlook is the most likely, especially when averaged over a long period of time and thus recommended for basic planning, there are other scenarios that could occur with almost immediate impact on short-term planning.

2.6.1 Low Economic Scenario

The low scenario assumes Japan and West Germany are not able to adapt to the massive appreciation of their currencies and with little effective domestic stimulation enter into a recession by 1988. Also, the U.S. trade deficit shows no marked improvement despite the significant depreciation of the dollar over the last 2 years. Inability to continue obtaining foreign financing for the deficits leads to increased interest rates and further dollar slippage. The U.S. slips into recession by 1988 and further exacerbates the world situation. Better economic conditions would not return until the early 1990s when a period of sustained growth would begin.

The recession would impact B.C.'s export oriented economy almost immediately with construction slowdowns and reduced exports of primary goods, e.g. lumber. B.C. would again be slow to recover from the recession as commodity prices, e.g. mining and forestry related, remain weak until the mid to late 1990s. It would not be until the late 1990s that B.C. would return to moderate economic growth under this scenario.

2.6.2 High Economic Scenario

The primary underlying assumption of the high scenario is the successful implementation of reflationary policies by the governments of Japan and West Germany. As a result, the U.S. trade and budget deficits are steadily reduced, and exchange and interest rate stability achieved. The result is a prolonged period of strong economic growth starting in 1990 and lasting until the early 2000s when it slows to more moderate levels.

The renewed strength of the U.S. and world economies would have significant positive effects on the export oriented B.C. economy. External demand would lead to higher commodity prices in the mining and forest sectors and thus the primary industries would show renewed vigour. While growth rates in B.C. initially would lag behind Canada as a whole and the U.S., higher growth rates would emerge in the early 1990s followed by a long period of strong economic growth.

SECTION 3.0 - PROBABLE ELECTRIC FORECAST

The population, economic, sectoral and energy price forecasts described in the previous section are translated into electricity requirements using a "top down/end use" approach to forecasting. The top down aspect of the approach entails the use of the population and economic forecasts and sectoral outlooks to project the household formation, commercial activity and industrial production that generate the need for electricity. The end use focus consists of analysis of how various customers presently use electricity and how consumption patterns are likely to change in the future.

The effects of energy price changes are examined by first establishing the scope customers have for changing electricity use by measures such as: installing more efficient appliances and higher levels of insulation, choosing an alternative source of energy for heating, switching to more efficient lighting, substituting other energy sources or modifying the way electricity is used in existing industrial processes, changing industrial processes, or self-generating electricity rather than purchasing.

Refer to Appendix A for a more detailed discussion of the forecast methodology used.

The forecast is prepared in detail, i.e. on a year-by-year basis for the first 10 years (through 1997/98). The following 10 years (through 2007/08) rely on trend projections tied to the long-term economic outlook. No specific timing of projects is assumed. The discussion in this section deals primarily with the first 10 years of the forecast.

The principal components of the 1987 Probable Load Forecast to 1997/98 are summarized in Table 3-1. A discussion by forecast sector follows.

3.1 RESIDENTIAL SALES

The residential sector accounts for 28 percent of B.C. Hydro's total electricity sales. With a large base of over one million accounts, growth in sales is generally steady in the short term, influenced mainly by the effect of weather on the electric space heating portion of the load. In the longer term sales growth is most dependent upon the population increase, the share of accounts using electricity for space heating, and the penetration rate of energy efficiency improvements. For the 10-year forecast horizon sales are expected to grow at an average annual rate of 2.4 percent compared to a 10-year historic growth rate of 3.8 percent per year.

Table 3-1

B.C. HYDRO ELECTRIC BILLED SALES AND GROSS REQUIREMENTS - 1997/98

Category (a)	Actual 1986/87 Sales (GW.h)	Increase in Sales - 1986/87 to 1997/98 (GW.h)	Projected 1997/98 Sales (GW.h)	Avg. Ann. Growth Rate: 1986/87 to 1997/98 (%/yr)
Residential	9,666	2,856	12,522	2.4
Commercial	8,678	3,674	12,352	3.3
Industrial	15,348	4,592	19,940	2.4
Other (b)	622	142	764	1.9
Total Billed Sales	34,314	11,264	45,578	2.6
Losses & Accruals	3,992	-	5,932	-
Gross Requirements	38,306	-	51,510	2.7

(a) The industrial and commercial categories do not correspond to B.C. Hydro's Rate categories. A breakdown of the above industrial and commercial sales into B.C. Hydro rate categories is presented in Tables 3-3 and 3-4.

(b) Inter-utility transfers (including WKP&L) and firm export (including SCL).

The determination of the growth in energy sales starts with forecasts of population and account formation. The population forecast described in the previous section reflects an increase of about 400,000 between now and 1997, and represents an average annual growth rate of 1.26 percent. Projecting the number of residential accounts involves the estimation of household formation patterns for various age groups. Overall the number of people per household is still declining, although at a slower rate than in the past. By 1997 we expect the average to be about 2.37 people per residential account in the B.C. Hydro service area. This results in an average annual account growth rate of 1.9 percent. Our account calculations are confirmed in the short term by an extensive system of detailed account forecasts compiled by the Operating staff in the regions.

The electric heating share of account additions is the most difficult component of the residential forecast to estimate. Some of the influencing factors are perceived relative energy prices, builder preferences (particularly with regard to equipment and installation costs), government programs and support, and the level of multiple versus single family construction in the short and long term. In developing the forecast, the short term is based almost exclusively on the regional information. The longer term is influenced by relative energy prices and the changing housing mix. By 1997 the number of residential accounts with electric space heating is expected to rise from 18.2 percent to 23.9 percent. This assumes that natural gas will not be available on Vancouver Island within the forecast period. Also the number of conversions off oil to electricity are expected to continue at current levels of about 1,200 per year on Vancouver Island.

Average annual electrical consumption for purposes other than space heating is starting to level out, compared to fairly significant increases during the 1960s and 1970s due to improved appliance efficiencies and the approaching full penetration of many appliances. If the push towards new conservation were to continue we could see declining average use trends. In this forecast, however, further conservation improvements are not seen to be as great as in the past as electricity prices are expected to increase at less than the rate of inflation. These factors combine to limit and offset the continuing efficiency improvements that will yet be realized. The forecast is for non-heating average annual use to increase from the current 8,400 kW.h per year to 8,500 kW.h per year by 1997. Impacts of Demand Side Management programs could, however, influence this trend (see Section 5.0).

Average use for space heating has been declining steadily each year on a weather normalized basis. Particularly since 1980 the increasing penetration of wood stoves and their level of use has contributed to that effect. In the forecast period reductions in average use will continue as new electrically heated housing comes on line, being better insulated and using less than the existing average.

Table 3-2

RESIDENTIAL ELECTRIC SALES FORECAST
(Billed Basis, No Adjustment For Accrual)

Fiscal Year	Average Residential Accounts (000)	Percent Electric Heating (%)	Annual Average Use Per Account: Non Electric Heating (kW.h)	Electric Heating (kW.h)	All Accounts (kW.h)	Total Sales (GW.h)
1976/77 (Actual)	782.7	7.4	7,588	19,380	8,465	6,625
1985/86 (Actual)	1,016.5	17.5	8,429	15,318	9,635	9,794
1986/87 (Actual)	1,033.6	18.2	8,300	14,068	9,352	9,666
Avg. Annual Growth (%) 10 years:						
76/77 - 86/87	2.8%	9.4%	0.9%	-3.2%	1.0%	3.8%
FORECAST						
1987/88	1,051.9	18.7	8,418	14,781	9,606	10,105
1988/89	1,072.0	19.2	8,418	14,701	9,621	10,314
1989/90	1,092.4	19.6	8,420	14,636	9,640	10,531
1990/91	1,113.2	20.1	8,421	14,570	9,657	10,751
1991/92	1,134.5	20.6	8,423	14,495	9,675	10,976
1992/93	1,156.2	21.1	8,433	14,423	9,699	11,215
1993/94	1,178.3	21.7	8,445	14,349	9,725	11,459
1994/95	1,200.7	22.2	8,467	14,290	9,762	11,722
1995/96	1,223.6	22.8	8,493	14,236	9,802	11,994
1996/97	1,246.7	23.4	8,503	14,212	9,837	12,263
1997/98	1,270.2	23.9	8,504	14,165	9,858	12,522
Avg. Annual Growth (%) 11 years:						
86/87 - 97/98	1.9%	-	0.2%	0.1%	0.5%	2.4%

Combining these average use trends with the account projections results in residential sales that will increase from an annual level of 9,666 GW.h in 1986/87 to 12,522 GW.h in 1997/98, an increase of 30 percent over the period.

3.2 COMMERCIAL SECTOR

Commercial electricity sales will grow more rapidly over the next 10 years than either the residential or industrial sectors. The commercial share of sales will increase from 25 percent to 27 percent by 1997/98. This projection is based on the provincial long-term economic outlook which shows the commercial sector components of GDP rising in importance to 74 percent of total output by 1997.

While growth of floor space stock in various areas of the commercial sector has been dampened at times over the last several years in response to general economic conditions, activity has been relatively buoyant and growth rates are again rising in the trade, service, and institutional sectors. Although much of the recovery in 1985 and 1986 has been attributed to Expo, the level of post-Expo activity is suggesting a continuation of physical expansion. As an example, in 1983 the trade sector added a total of just under 1 million ft^2 in B.C. In 1985 and 1986 it grew at an annual rate of about 2.3 million ft^2 and is currently (1987) running at an annual rate of 2.15 million ft^2. Growth in office floor space has been declining since 1981 in accordance with increasing vacancy rates but may now have bottomed out in this sector as year-to-date figures indicate a 40 percent increase in office construction over last year. The overall forecast of stock growth in the commercial sector is an average annual rate of 2.9 percent to 1997.

Average consumption trends in the commercial sector continue to climb marginally even though the technical analysis of motor and lighting loads in all types of buildings indicate reductions in average use trends. It appears that new applications such as automation in offices continue to push average use trends up faster than the reductions from improved application efficiencies. The existing trend combined with the current outlook for lower real electricity prices leads to our forecast showing an increase in average annual use in the commercial sector of 4 percent over the next 10 years or 0.4 percent per year.

The resultant sales forecast is for an average annual increase of 3.3 percent rising from 8,678 GW.h in 1986/87 to 12,352 GW.h in 1997/98. The highest growth components within the commercial sector are trade and community, business, and personal services. Detailed projections are shown in Table 3-3.

Table 3 - 3

COMMERCIAL ELECTRIC SALES FORECAST
(Billed Basis, No Adjustment For Accrual)

Fiscal Year	By Standard Industrial Classification (SIC)							By Rate Category		
	Transportation Communication & Other Utilities (GW.h)	Wholesale & Retail Trade (GW.h)	Finance, Insurance & Real Estate (GW.h)	Community, Business & Pers. Serv. (GW.h)	Public Admin. & Defence (GW.h)	Unclassified (GW.h)	Total Sales (GW.h)	General (GW.h)	Trans. Rate (GW.h)	Other (a) (GW.h)
1986/87 (Actual)	1,326	2,008	1,643	2,914	638	149	8,678	7,948	353	377
FORECAST										
1987/88	1,350	2,079	1,709	3,017	656	152	8,962	8,220	360	382
1988/89	1,381	2,145	1,758	3,098	667	156	9,206	8,450	365	391
1989/90	1,414	2,210	1,808	3,179	679	160	9,450	8,683	370	397
1990/91	1,449	2,276	1,858	3,274	692	165	9,715	8,933	375	407
1991/92	1,487	2,351	1,914	3,386	706	170	10,014	9,223	375	416
1992/93	1,529	2,433	1,973	3,514	722	176	10,347	9,543	380	424
1993/94	1,573	2,521	2,036	3,658	738	182	10,709	9,889	385	435
1994/95	1,619	2,612	2,101	3,816	756	188	11,092	10,257	390	445
1995/96	1,664	2,703	2,169	3,987	774	195	11,492	10,646	390	456
1996/97	1,711	2,798	2,240	4,171	793	202	11,914	11,054	395	465
1997/98	1,757	2,893	2,314	4,367	812	210	12,352	11,477	400	475
Avg. Annual Growth (%) 11 years: 86/87 - 97/98	2.6%	3.4%	3.2%	3.7%	2.2%	3.2%	3.3%	3.4%	1.1%	2.1%

(a) The 'Other' rate category includes Irrigation, Street Lighting and B.C. Hydro Own use.

3.3 INDUSTRIAL SECTOR

Industrial electricity sales by B.C. Hydro are predominantly associated with the forest industry with nearly 65 percent of the sales in 1986/87 going to the paper and allied products, wood manufacturing and chemicals (produced mainly for chemical pulping) sectors. This dependence for sales on one industry is projected to increase to 70 percent by 1997/98. The mining sector is the other major user of purchased electricity but its share is expected to decrease from over 20 percent presently to just over 10 percent in 1997/98. Table 3-4 indicates the present shares and projections for 1997/98.

TABLE 3-4

INDUSTRIAL SALES
PERCENT SHARE BY SIC SECTOR

Sector	1986/87 (actual)	1997/98
Metal mines	15.9	7.1
Mineral fuels	4.6	4.3
Other primary industries	1.5	1.5
Wood manufacturing	11.2	10.4
Paper and allied products manuf.	45.0	50.5
Chemical and chem prod. manuf.	9.6	9.5
Food and beverage manuf.	2.3	2.2
Primary metal manuf.	1.0	1.1
Non-metallic mining prod. manuf.	2.2	2.2
Petroleum and coal prod. manuf.	2.4	1.6
Miscellaneous manuf.	3.1	3.3
Unspecified	-	5.0
Construction	1.1	1.3

Industrial sales are projected to grow by 4592 GW.h between 1986/87 and 1997/88 for an average annual growth rate of 2.4 percent. The 4592 GW.h represents 40 percent of the total growth in domestic sales expected. Table 3-5 presents a breakdown of the industrial sales projections by Standard Industrial Classification (SIC) with discussion by category following.

3.3.1 Metal Mines

The large open pit copper and molybdenum mines are the major users of purchased electricity in this sector. The gold and silver mines are small users of purchased electricity. With the poor long-term price outlook for copper and molybdenum no major new mines are expected to be developed in this century. As well, many of the existing mines have been highgrading

(limited stripping) in order to remain in business and with depletion of economic ore are expected to close in the next few years. By 1997/98 the only major existing mines expected to be still open are Highland Valley Copper and Placer-Endako. The result in electricity sales is a decrease of 1000 GW.h by 1997/98.

3.3.2 Mineral Fuels

The major electricity users in this sector are the large open pit coal mines. The natural gas liquids (NGL) extraction plant at Taylor also is a major user of purchased electricity. Little change is anticipated in the present operating levels of the major coal mines through the period to 1997/98. Addition of two small, thermal coal mines in the mid 1990s is projected to add 50 GW.h. As well, operation of the NGL facility at full capacity is expected to add another 50 GW.h.

3.3.3 Other Primary Industries

The other primary industries consist of agriculture, forestry, fishing, mines other than metal or coal, quarries and sand pits and incidental services. Only moderate growth, in line with the sectoral GDP's, in electric sales is expected.

3.3.4 Wood Manufacturing

In the short term, sales to the wood manufacturing sector are expected to decrease due to a combination of the impact of the softwood lumber export tax (being replaced by a new stumpage fees system) and a decrease in the U.S. housing starts. Long-term growth in electric sales is limited as harvesting is approaching the allowable annual cut. The major portion of the projected increase in sales of 360 GW.h by 1997/98 is for new electric wood drying load. A moderate increase in sales is expected from additional value added production as well.

3.3.5 Paper and Allied Products Manufacturing

The paper and allied products sector is projected to account for the majority of growth in electric sales to the industrial sector through 1997/98. The increase of over 3100 GW.h is actually 600 GW.h higher than that when sales under the short-term Turbine Turndown (Rate 1844) marketing program are removed from the base year of 1986/87. The mechanical pulping processes now involved in nearly all new capacity additions are very electric intensive. Typically they are three to four times more electric intensive per unit

output than the chemical (kraft) process and with small steam requirements do not lead to co-generation being installed.

Approximately 2500 GW.h of new load is expected to be added by 1990/91. The majority of this is for committed expansions/modernizations or new projects. New projects include Fibreco's Chemi-thermal Mechanical Pulp (CTMP) mill near Taylor and CIP's CTMP/paper mill at Gold River. Expansions/modernizations proceeding include CTMP additions at M&B - Powell River, Quesnel River Pulp, BCFP - Crofton and CFI-Elk Falls. Finlay at Mackenzie is adding newsprint capacity. All involve purchased electricity increases in the range of 100 GW.h to 500 GW.h each.

Some capacity increases are also projected for the mid 1990s. Additional newsprint capacity at existing mills and two greenfield CTMP mills are expected, one associated with paper production and one for market CTMP. Some additional co-generation, in the order of 300 GW.h, is also expected in this time frame and incorporated into the forecast.

3.3.6 Chemical and Chemical Products Manufacturing

Electric sales to the chemical sector are largely to the six major facilities that produce chemicals mainly for the B.C. chemical pulp industry. The production processes, for sodium chlorate and chlorine/caustic soda, are very electric intensive. Little growth is seen in B.C. for chemical pulp and hence these chemicals. However, with low long-term projected electricity rates, additional capacity is projected for the 1990s with development of further export markets.

There is presently one major customer in this category associated with the natural gas industry, that is the ammonia plant at Kitimat. No change is expected in operation and no additional natural gas associated manufacturing facilities are expected through 1997/98.

3.3.7 Other Manufacturing

Included in this category are the remaining manufacturing industries plus unnamed or unspecified load. The major electricity users encompass:

- Food and Beverage - Long-term growth in sales is based on sectoral GDP which is expected to grow at a rate moderately lower than total GDP. Sales of 352 GW.h in 1986/87 are projected to increase to 446 GW.h in 1997/98.

- Primary Metal - The existing aluminum and lead/zinc smelting capacity in B.C. is served by self-generation (Alcan and Cominco). The load served by B.C. Hydro is small, 156 GW.h in 1986/87, and is expected to increase only moderately to 217 GW.h in 1997/98. Possible longer term smelting projects could be served by B.C. Hydro. Copper, ferrosilicon, magnesium and silicon smelting projects could each add 200 GW.h to 500 GW.h in electricity sales. Specifically, 400 GW.h is included by 2007/08.

- Non-metallic Mineral Products - Cement and fibreglas plants are the large purchased electricity users in this category. Growth is projected to follow the construction industry and sales increase from 339 GW.h in 1986/87 to 430 GW.h in 1997/98.

- Petroleum and Coal Products - The oil refineries are the major electricity users. With one or more of the refineries expected to close, sales are expected to drop from 368 GW.h in 1986/87 to 323 GW.h in 1997/98.

- Miscellaneous Manufacturing - This non resource-based remainder encompasses such sectors as the high technology industries. While not electric intensive in relation to sectoral GDP, there is an expectation that this area will have the highest sectoral GDP growth of all the industrial areas. Electricity sales are expected to run parallel and grow from 476 GW.h in 1986/87 to 664 GW.h in 1997/98.

- Unspecified Load - By 1997/98 an allowance of 1000 GW.h is provided for unnamed, new load. This is more than was allowed for in last year's forecast and is primarily in response to the lower long-term real electricity prices assumed in this year's forecast. The load is shown in the manufacturing area but could partially occur in other areas i.e. primary industries.

3.3.8 Construction

Electric sales to the construction industry are small when compared to the sector's relative importance to total GDP. Sales are projected to increase in line with sector growth from 175 GW.h in 1986/87 to 252 GW.h in 1997/98.

12-Jan-88

Table 3-5
INDUSTRIAL ELECTRIC SALES FORECAST
(Billed Basis - No adjustment For Accrual)

Fiscal Year	By Standard Industrial Classification (SIC)									By Rate Category		
	Primary Industries			Manufacturing				Construction				
	Metal Mines (GW.h)	Mineral Fuels (GW.h)	Other (GW.h)	Wood (GW.h)	Paper & Allied (GW.h)	Chemicals & Prod. (GW.h)	Other (GW.h)	(GW.h)	Total (GW.h)	General (GW.h)	Trans Rate (GW.h)	Domestic Marketing (a) (GW.h)
1986/87 Actual	2,443	713	233	1,719	6,910	1,471	1,684	175	15,348	3,024	10,781	1,543
FORECAST												
1987/88	2,521	719	243	1,800	7,080	1,549	1,704	175	15,791	3,000	11,285	1,506
1988/89	2,578	732	248	1,670	7,803	1,638	1,739	183	16,592	2,965	12,245	1,382
1989/90	2,390	749	254	1,700	8,331	1,675	1,737	189	17,026	3,086	13,230	710
1990/91	2,107	765	260	1,780	8,835	1,708	1,755	196	17,406	3,226	13,815	365
1991/92	2,100	765	266	1,850	9,167	1,677	1,775	203	17,804	3,351	14,420	33
1992/93	2,131	771	272	1,930	9,345	1,667	1,927	211	18,254	3,484	14,770	0
1993/94	2,162	777	278	1,960	9,398	1,704	2,073	220	18,572	3,572	15,000	0
1994/95	2,093	792	284	1,990	9,471	1,747	2,331	228	18,936	3,661	15,275	0
1995/96	1,794	808	290	2,020	9,764	1,794	2,580	236	19,286	3,751	15,535	0
1996/97	1,590	828	295	2,050	9,917	1,841	2,826	244	19,591	3,836	15,755	0
1997/98	1,406	854	301	2,080	10,079	1,889	3,080	252	19,940	3,925	16,015	0
Avg. Annual Growth: % 11 years:												
86/87-97/98	-4.9%	1.7%	2.3%	1.7%	3.5%	2.3%	5.6%	3.4%	2.4%	2.4%	3.7%	-

(a) See Table 5-1 for breakdown of Domestic Marketing.

3.4 OTHER SALES

Included here are inter-utility and firm out of province sales. Total sales in 1986/87 of 662 GW.h are projected to grow to 764 GW.h in 1997/98. Seattle City Light (SCL) sales under the Skagit agreement are 318 GW.h annually. West Kootenay Power and Light (WKP&L) requirements are projected to rise from 15 GW.h in 1986/87 to 45 GW.h in 1997/98. The requirements are associated mainly with peaking capacity as WKP&L is proposing to install capacity to supply the majority of their incremental energy requirements. Beyond 1997/98, WKP&L requirements become more significant and are projected to reach 660 GW.h in 2007/08. The City of New Westminster accounts for most of the remaining sales, with actual sales of 268 GW.h in 1986/87 projected to reach 370 GW.h in 1997/98. The remaining sales are to Point Roberts and Hyder in the U.S. and to Alberta.

3.5 GROSS REQUIREMENTS

Gross electric energy requirements are calculated by adding losses to the sales estimates with peak demand projections then calculated via the use of load factors. Calculations of losses and peaks are based on historical trends.

B.C. Hydro Domestic System is defined to include all firm domestic sales including the Firm Industrial Marketing Programs. Excluded are the Interruptible Marketing (IM) Programs, Demand Side Management (DSM) Programs and sales to West Kootenay Power and Light (WKP&L) and Seattle City Light (SCL).

Energy losses are calculated in two steps. First, distribution sales (customers not served at transmission voltage) are added and multiplied by 6.9 percent to determine distribution losses. Then, distribution sales plus distribution losses plus transmission customer sales are added and multiplied by 8.3 percent to determine transmission losses. The result, which closely approximates historical averages, is total losses taken as a percentage of total sales averaging 13.0 percent.

Peak demand is also calculated in two steps. Distribution sales plus distribution and associated transmission losses are added and then, using an annual load factor of 59.4 percent, the peak contribution from distribution customers is calculated. Then, transmission customer sales plus associated transmission losses are added and a load factor of 80.0 percent applied to determine a peak contribution. The result is a system load factor in the 65 percent to 66 percent range.

The Integrated Domestic System is defined as the above Domestic System less the Non-Integrated System. The non-integrated areas, in 1986/87, accounted for gross requirements of 167 GW.h and a peak of 33 MW.

Separate system planning functions exist for the integrated and non-integrated areas. The Integrated Domestic System is the basis for integrated system planning studies. The consideration of WKP&L, SCL, IM Programs and DSM Programs are included as the planning function requires.

West Kootenay Power and Light and Seattle City Light gross requirements and peak impact are calculated separately from the Integrated Domestic System and treated as "add ons". Sales and peak demand requirements are projected and treated separately. Transmission losses of 7.0 percent are assumed on both sales and peak. The peak month for the B.C. Hydro integrated domestic system is projected to be December and thus the WKP&L and SCL peak estimated requirements for that month are used. Diversity in the range of 70 percent to 75 percent is allowed and the resultant peaks are estimated to be those coincident with the B.C. Hydro integrated system peak.

SECTION 4.0 - ELECTRIC FORECAST UNCERTAINTY

Actual electricity sales will vary from the probable forecast for two main reasons: a higher or lower intensity of electrical use for the given economic/demographic forecasts on which the energy forecast is based; or variations in these economic/demographic forecasts. Examples of variations in intensity of electricity use are weather variation (from normal) which is primarily a short-term consideration impacting revenue projections, and in the longer term the choice of industrial process such as mechanical (very electric intensive) versus chemical pulping. Economic forecasts in the short term can vary due to strikes/lockouts that can occur, with recent examples in the forest industry. In the longer term, variations in population, and economic growth (overall GDP as well as composition) can occur.

This section is presented to provide a flavour for the uncertainties inherent in demand forecasting. The first two parts (4.1 and 4.2) deal with the probable forecast and the sensitivities and probabilities surrounding it. The third part (4.3) looks at different basic economic scenarios and the resultant expected energy forecasts. The fourth part (4.4) looks at historical forecasts and actual deviations based on them.

4.1 PROBABLE FORECAST SENSITIVITIES

The short-term and long-term forecasts are sensitive to different factors and considerations. Short-term considerations are primarily revenue related whereas long-term are system planning related.

4.1.1 The two main quantifiable factors which can appreciably affect the short-term forecast and thus impact projected revenues significantly are:

- Strikes/Lockouts - Sales to the forest industry have in the past been the most affected by strikes/lockouts. Shutdowns of pulp and paper mills also affect the electric intensive chemical industry that serves the chemical pulp industry. With the projected growth in sales to the pulp and paper industry, B.C. Hydro will become even more sensitive to shutdowns (and downturns) in the industry. Refer to Table 4-1 for recent examples of impacts of strikes/lockouts. Sales in 1988 are vulnerable because of the Forest Industry bargaining calendar.

TABLE 4-1

IMPACTS OF STRIKES/LOCKOUTS

Year	Shutdown	Estimated Loss in Sales (GW.h)	Estimated Loss in Revenue (M$)
1981/82	Forest industry involving all areas i.e. pulp and paper, wood manufacturing and chemical industry	1150	28
1983/84/ 1984/85	Pulp and paper and chemical plants affected	980	22
1986/87	Wood manufacturing with marginal impact on pulp and paper mills	270	7

NOTES

1. Estimated losses in sales and revenue based on direct sales affected only.

2. Revenue loss based on current (1987) rates.

- Weather - With the increasing overall penetration of electric heating, particularly in the residential sector, electricity sales are becoming more and more sensitive to winter temperature averages. Table 4-2 estimates sales variations due to variations in degree days over the last few years.

TABLE 4-2

WEATHER IMPACT ON SALES

Year	Heating Season Warmer or (Colder) than Normal (Degree Days in %)	Estimated Gain or (Loss) in Sales (GW.h)	Estimated Gain or (Loss) in Revenue (M$)
1984/85	(7)	310	13
1985/86	(2)	80	4
1986/87	8	(350)	(15)

4.1.2 Major factors which can markedly affect the longer term forecast are:

- Energy Prices - Changes in real electricity prices will impact on the amount and rate of conservation being carried out. Changes in electricity prices relative to oil and natural gas prices will affect such items as electric heating penetration, choice of new equipment and some industrial processes.

- Economic Growth (GDP) - Overall economic growth has a direct link to expected electric sales. Within the overall GDP, however, many of the sectors are more electric intensive than others. The industrial sectors, in general, use much more electricity per unit GDP than the commercial sectors do.

- Population Growth - Variations in population growth directly affect the residential sector sales forecast and indirectly affect the commercial sector sales forecast.

- Major Projects - It is not possible to quantify an individual project in terms of impact on overall (or even sectoral) GDP. Thus considerable variation in electricity requirements are possible within a few electric intensive developments.

Table 4-3 provides a comparison of the estimated impact of changes in these variables on the forecast with the last year (1997/98) of the detailed forecast chosen for the comparative year.

TABLE 4-3

FORECAST SENSITIVITIES - 1997/98

Forecast Element	1987 Forecast Probable Assumption	Alternative Assumptions	Impact On 1997/98 Sales (GW.h)
1) Electricity Prices	No price increase for 8 years	1) 10% increase by 1990	-980
		2) 30% increase by 1994 (approx. flat real)	-2900
2) Economic Growth			
- Total GDP	Average annual growth of 2.9% to 1997	1) Average of 3.4%	1800
		2) Average of 2.4%	-1700
- Commercial Sector (73% of total GDP)	Average annual growth of 2.9% to 1997	1) Average of 3.4%	750
		2) Average of 2.4%	-720
- Industrial Sector (27% of total GDP)	Average annual growth of 2.8% to 1997	1) Average of 3.3%	1080
		2) Average of 2.3%	-1050
- Community, Business & Personal Services (20% of total GDP)	Average annual growth of 3.2% to 1997	1) Average of 3.7%	280
		2) Average of 2.7%	-260
- Paper & Allied Sector (2.8% of total GDP)	Average annual growth of 3.4% to 1997	1) Average of 3.9%	700
		2) Average of 2.9%	-660
3) Population Growth	Average annual growth of 1.26% to 1997	1) Average of 1.76%	+800
		2) Average of 0.76%	-710
4) Major Projects			
- Greenfield CTMP or CTMP/paper mill	4 Included	1) Addition or subtraction of 1	±450
- Typical metal (copper) mine	7 Closing in period	1) 1 still open	Range of 100 to 500
5) Annual Growth in Sales	In the mid 1990s, the average annual growth in domestic sales that translates to a 1-year advancement or delay of the forecast is:		1000

NOTE:

In the economic growth comparisons no change in electric intensity is assumed.

4.2 PROBABILITY DISTRIBUTION AROUND PROBABLE FORECAST

Actual electrical sales in a given future year will undoubtedly vary from the probable forecast. Uncertainties involving issues such as energy intensity in industrial sectors, energy substitution, effects of government grants and marketing programs, social trends, investment climate, and other factors could vary considerably even if GDP is assumed to precisely follow the probable economic forecast. B.C. Hydro must carefully consider the uncertainties associated with its forecast and plan in a manner that responds to this uncertainty.

In the previous forecast (1986), B.C. Hydro attempted to formally quantify the uncertainties inherent in its forecast through the use of probabilities. In that exercise, probabilities were subjectively attached to the high and low bands surrounding the probable forecast, on an aggregate basis, after the forecast was completed. For the current forecast, a new method of assessing probability distributions was developed for B.C. Hydro by McDaniels Research and applied on a trial basis.

The objective of the new method was to develop a probability distribution demonstrating uncertainties around the probable load forecast, assuming provincial GDP and population growth are held constant at the levels shown in the probable economic forecast. Thus, the probability distribution presented below reflects uncertainties in variables such as future energy intensity in industries and social trends, but ignoring the possibility of higher or lower overall economic growth.

The probability assessment proceeded as follows:

- an uncertainty model employing Monte Carlo simulation methods was constructed to quantify and combine probability distributions on key variables;

- the model was structured in terms of five sectors: pulp and paper, metal mining, other industrial, residential and commercial;

- for each sector, one or two key variables were identified that have the largest effects on uncertainty over electrical sales in that sector. For example, the rate of new household formation has a major effect on the number of residential accounts, given a population forecast;

- a trained probability assessor worked with experts within B.C. Hydro's forecasting group to subjectively assess probability distributions over each of these key variables;

- the uncertainty model was then used to combine these probability distributions and other factors to develop probability distributions for sales in each sector, which were combined into an overall sales forecast distribution;

- the key assumptions for these assessments were that total GDP, population, and sectoral GDP were held constant at the probable forecast level, energy prices were set at the levels assumed for the probable forecast, and weather was at the normal level; and

- the probability distributions for variables in all the sectors were assumed to be statistically independent.

Figure 4-1 illustrates the shape of the probability distribution surrounding the 1991 probable forecast. It is roughly bell-shaped, but considerably flatter than a standard normal distribution. Figure 4-2 shows confidence intervals surrounding the probable forecast, over the period from 1991 to 1997. Specifically, the percentage indicates the probability that the load will be at or below the level shown. The 80 percent band (that between the 10% and 90% lines) is narrower than the width of the uncertainty bounds (probable low - probable high) shown around last year's forecast, although the underlying assumptions are somewhat different.

Finally, Table 4-4 presents the estimated mean and standard deviation for each sector and for total electric sales for 1991 and 1997. The table shows that for 1991, the largest uncertainties (expressed in terms of standard deviations of the distributions) occur in the metal mining and other industrial sectors and in the residential sector. The reasons are:

- the uncertainty over activity in the metal mining sector due to world prices;
- the diversity of the other industrial sector which makes it difficult to predict; and
- uncertainty over the role of electric heating in the residential sector.

By 1997, uncertainty is greater in all sectors, but particularly in the residential and metal mining sectors.

For planning purposes, the 80 percent confidence interval has been chosen and referred to as the probable low to probable high range. See Table 4-6 for the resulting integrated system gross load forecasts.

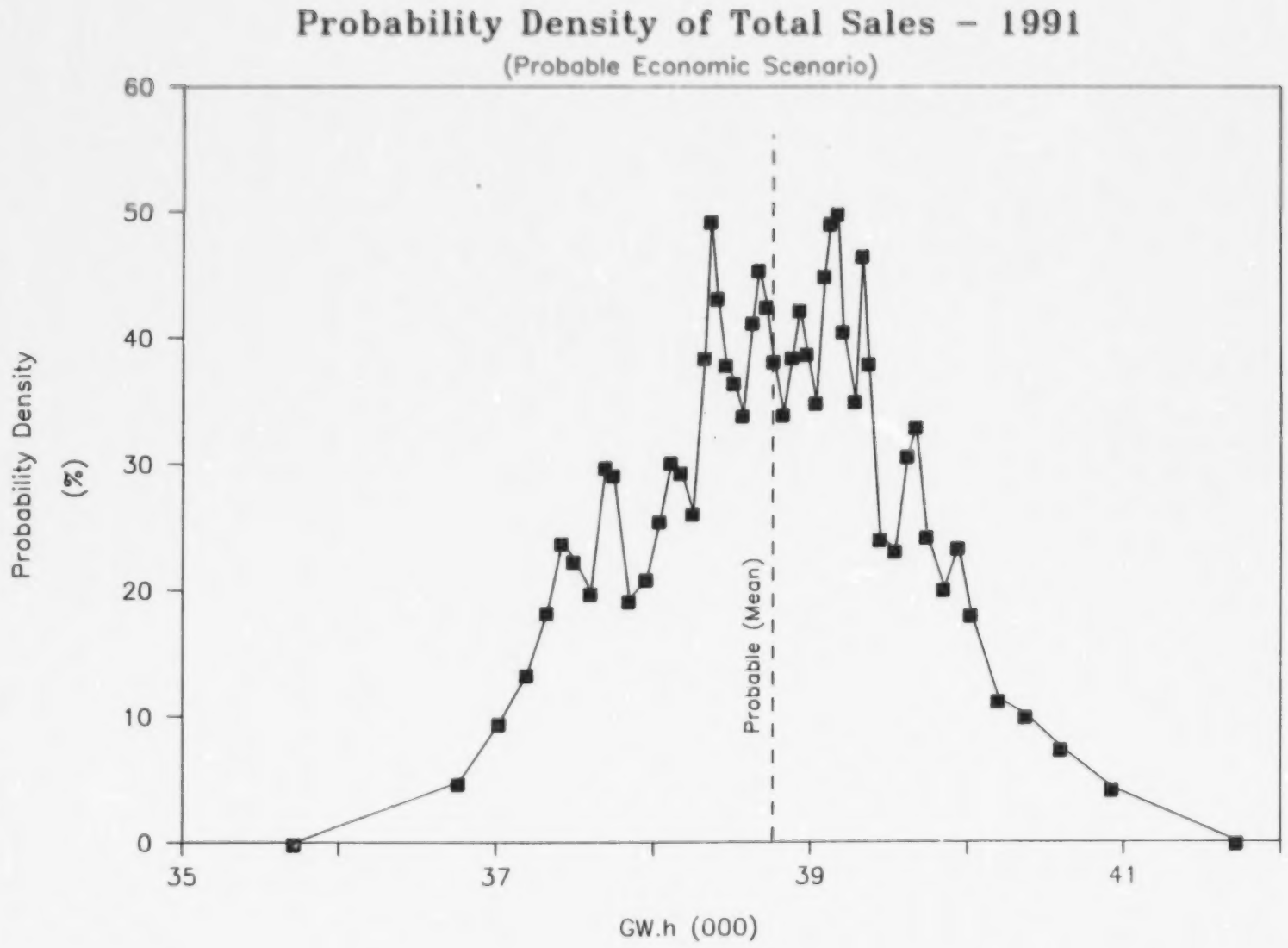
Probability Density of Total Sales - 1991
(Probable Economic Scenario)
Probability Density
(%)
60
50
40
30
20
10
0
35
37
39
41
GW.h (000)
Probable (Mean)

Figure 4-1

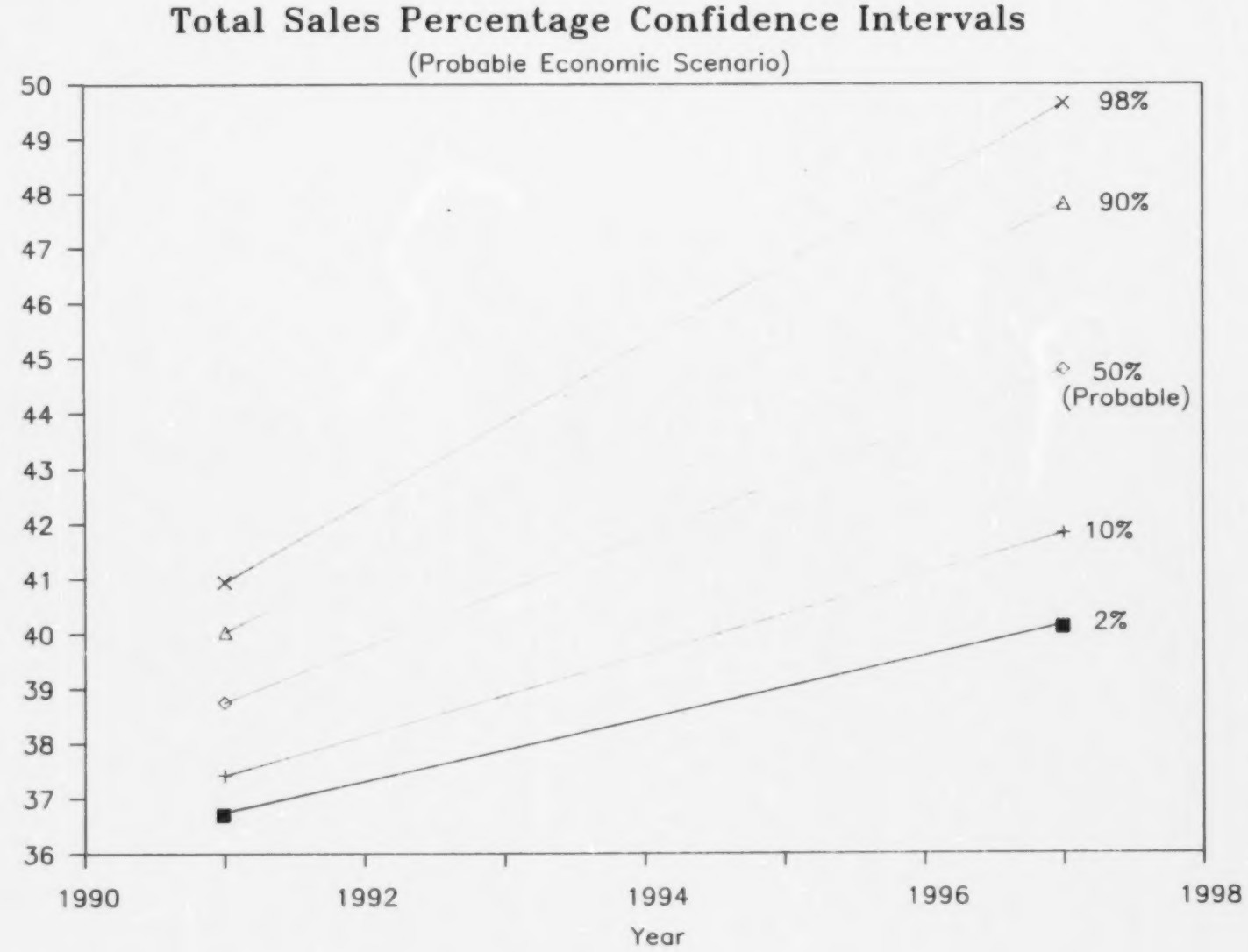
Total Sales Percentage Confidence Intervals
(Probable Economic Scenario)
GW.h (000)
50
49
48
47
46
45
44
43
42
41
40
39
38
37
36
1990
1992
1994
1996
1998
Year
98%
90%
50%
(Probable)
10%
2%

Figure 4-2

TABLE 4-4

MEAN AND STANDARD DEVIATION

1991	Mean (GW.h)	Standard Deviation (GW.h)	Standard Deviation (%)
Residential	10 998	639	5.8
Commercial	10 009	287	2.9
Pulp & Paper	9 168	372	4.1
Metal Mining	2 089	192	9.2
Other Industrial	6 498	602	9.3
System	38 762	1 019	2.6

1997	Mean (GW.h)	Standard Deviation (GW.h)	Standard Deviation (%)
Residential	12 620	1 591	12.6
Commercial	12 322	748	6.1
Pulp & Paper	10 107	660	6.5
Metal Mining	1 378	613	44.5
Other Industrial	8 394	1 005	12.0
System	44 821	2 266	5.1

4.3 HIGH AND LOW SCENARIOS

The previous two subsections, 4.1 and 4.2, dealt with the probable load forecast, sensitivities to input parameter changes and the resulting probability distribution around the forecast. The underlying assumption was that the probable economic forecast would occur. There are, of course, other economic outcomes that could occur. This subsection takes the high and low economic scenarios described in Section 2.0 and provides alternate energy growth scenarios. Refer to Table 4-5 for a comparison of growth rates of economic assumptions and resultant energy forecasts and Table 4-6 for the energy forecasts.

TABLE 4-5

SCENARIOS
LOW - PROBABLE - HIGH

	Low	Probable	High
GDP (average %/year)			
- 1986 through 1997	1.7	2.9	3.4
- 1997 through 2007	3.1	2.8	3.1
Population (average %/year)			
- 1986 through 1997	0.91	1.26	1.59
- 1997 through 2007	1.30	1.42	1.59
Energy Prices	Same for all three scenarios		
Gross Domestic Load Requirements (average %/year)			
- 1986/87 through 1997/98	1.3	2.7	4.1
- 1997/98 through 2007/08	2.3	2.8	3.6

In preparing the energy forecasts based on the high and low economic scenarios, the same approach was used as in the probable forecast. The major simplifying assumption was no change in electric intensity within particular sectors. The result is high and low forecasts having similar uncertainties and probabilities (each in both an up and down direction) to the probable forecast. The band of possible error from the single line probable forecast is thus very wide.

TABLE 4-6
B.C. HYDRO ELECTRIC GROSS LOAD REQUIREMENTS FORECAST
TOTAL INTEGRATED SYSTEM (Including SCL and WKP&L)
July 1987 Forecast

Fiscal Year	LOW SCENARIO Total Gross Req'ts (GW.h)	Peak (MW)	P. LOW - 10% Total Gross Req'ts (GW.h)	Peak (MW)	PROBABLE Total Gross Req'ts (GW.h)	Peak (MW)	P. HIGH - 90% Total Gross Req'ts (GW.h)	Peak (MW)	HIGH SCENARIO Total Gross Req'ts (GW.h)	Peak (MW)
			(---------- Range of Probable Forecasts ----------							
1985/86 Actual	37,261	6,816	37,261	6,816	37,261	6,816	37,261	6,816	37,261	6,816
1986/87 Actual	38,139	6,467	38,139	6,467	38,139	6,467	38,139	6,467	38,139	6,467
1987/88	39,120	6,950	39,660	7,040	39,960	7,090	40,260	7,140	40,650	7,200
1988/89	39,350	6,980	40,740	7,200	41,330	7,300	41,920	7,400	42,660	7,530
1989/90	38,920	6,850	41,410	7,260	42,300	7,410	43,190	7,560	44,390	7,770
1990/91	39,210	6,910	42,100	7,390	43,290	7,590	44,480	7,790	46,310	8,100
1991/92	39,650	7,000	42,810	7,530	44,350	7,790	45,790	8,030	47,900	8,390
1992/93	39,790	7,060	43,350	7,650	45,520	8,010	47,040	8,270	49,260	8,650
1993/94	40,230	7,140	44,190	7,800	46,570	8,200	48,520	8,530	50,910	8,940
1994/95	41,140	7,300	45,030	7,950	47,740	8,410	50,010	8,800	52,750	9,270
1995/96	42,120	7,480	45,870	8,110	48,920	8,630	51,490	9,070	54,990	9,670
1996/97	43,140	7,660	46,710	8,270	50,070	8,850	52,980	9,340	57,240	10,060
1997/98	44,140	7,850	47,850	8,490	51,280	9,080	54,710	9,660	59,470	10,460
Avg. Annual Growth: %										
11 years:										
86/87-97/98	1.3%	1.8%	2.1%	2.5%	2.7%	3.1%	3.3%	3.7%	4.1%	4.5%
1998/99	45,090	8,020	48,890	8,670	52,640	9,320	56,420	9,960	61,620	10,840
1999/2000	46,140	8,210	50,030	8,880	54,120	9,580	58,250	10,280	63,970	11,260
2000/01	47,240	8,400	51,200	9,080	55,640	9,840	60,140	10,610	66,400	11,680
2001/02	48,430	8,610	52,490	9,310	57,290	10,130	62,170	10,970	68,980	12,140
2002/03	49,630	8,820	53,800	9,540	58,960	10,420	64,220	11,330	71,560	12,590
2003/04	50,810	9,030	55,140	9,770	60,680	10,720	66,330	11,690	74,200	13,050
2004/05	52,020	9,250	56,500	10,010	62,410	11,020	68,460	12,070	76,870	13,530
2005/06	53,290	9,460	57,920	10,250	64,220	11,330	70,680	12,450	79,640	14,000
2006/07	54,530	9,680	59,350	10,500	66,050	11,650	72,920	12,850	82,460	14,510
2007/08	55,790	9,910	60,830	10,770	67,930	11,990	75,230	13,260	85,410	15,040
Avg. Annual Growth: %										
10 years:										
97/98-07/08	2.4%	2.4%	2.4%	2.4%	2.9%	2.8%	3.2%	3.2%	3.7%	3.7%
21 years:										
86/87-07/08	1.8%	2.1%	2.2%	2.5%	2.8%	3.0%	3.3%	3.5%	3.9%	4.1%

4.4 COMPARISON OF HISTORICAL FORECASTS

Table 4-7 shows the variance from actual growth in the probable energy forecasts prepared from 1963 on and Fig. 4-3 is a graphical representation. Errors were magnified in the forecasts made from 1970 through 1975 because the second 5 years of those probable forecasts were trended to a high projection to ensure an adequate planning reserve.

TABLE 4-7
% ERROR*
YEARS AFTER FORECAST

Date Forecast Made	1	2	3	4	5	6	7	8	9	10	11
Sept. '63	-0.5	-3.5	-9.9	-16.4	-19.7	-24.8	-25.7	-28.1	-31.4	-35.6	-38.0
Sept. '64	-1.6	-3.1	-6.6	-8.0	-14.4	-15.6	-18.1	-22.8	-27.6	-31.3	-30.3
Sept. '65	-0.7	-3.4	0.0	-3.6	-4.5	-6.6	-11.6	-18.5	-22.7	-22.4	-19.5
Sept. '66	1.0	3.8	2.0	-0.5	0.1	-8.6					
Sept. '67	1.4	0.2	1.3	-0.2	-3.8	-9.5					
Sept. '68	-1.6	-1.9	-0.4	-2.6	-8.4	-11.7					
Sept. '69	0.1	1.9	-0.9	-4.4	-9.0	-7.4	-2.8	-7.0	-7.1	-7.4	-3.0
Sept. '70	-0.8	4.2	1.8	1.3	5.6	12.1	9.6	11.4	12.9	19.6	25.5
Sept. '71	0.6	0.9	1.2	6.7	14.7	12.5	15.0	16.5	23.8	29.5	35.7
Sept. '72	-1.8	-1.4	2.8	12.1	11.1	14.4	16.8	23.9	29.3	35.6	51.1
Sept. '73	0.5	4.8	14.0	13.0	17.7	20.5	29.5	36.7	43.5	60.1	68.8
Sept. '74	-0.5	5.3	5.3	12.7	16.7	25.2	31.2	38.9	56.3	64.8	63.5
Sept. '75	-0.6	2.2	5.0	9.9	18.6	26.1	32.6	49.1	58.2	57.2	63.7
Sept. '76	0.7	3.4	4.7	11.3	18.5	24.8	37.2	42.3	38.5	42.4	50.0
Sept. '77	0.4	-0.8	2.3	5.1	7.3	19.0	23.5	19.8	22.1	27.6	
Sept. '78	-1.4	2.0	2.8	5.3	16.7	23.2	19.7	21.7	26.2		
Sept. '79	1.2	3.0	7.6	20.7	27.1	22.5	21.1	24.1			
Sept. '80	0.9	5.6	18.5	24.5	21.9	22.9	26.0				
Sept. '81	-0.1	14.7	18.9	15.9	16.7	20.5					
Sept. '82	3.4	5.5	1.3	1.7	5.2						
Sept. '83	3.5	-0.6	0.3	1.5							
July '84	-4.7	-5.7	-4.0								
July '85	-2.2	-0.6									
July '86	0.6										

* Difference between forecast made 1 to 11 years prior to year indicated divided by actual. A negative sign indicates the forecast was lower than actual.

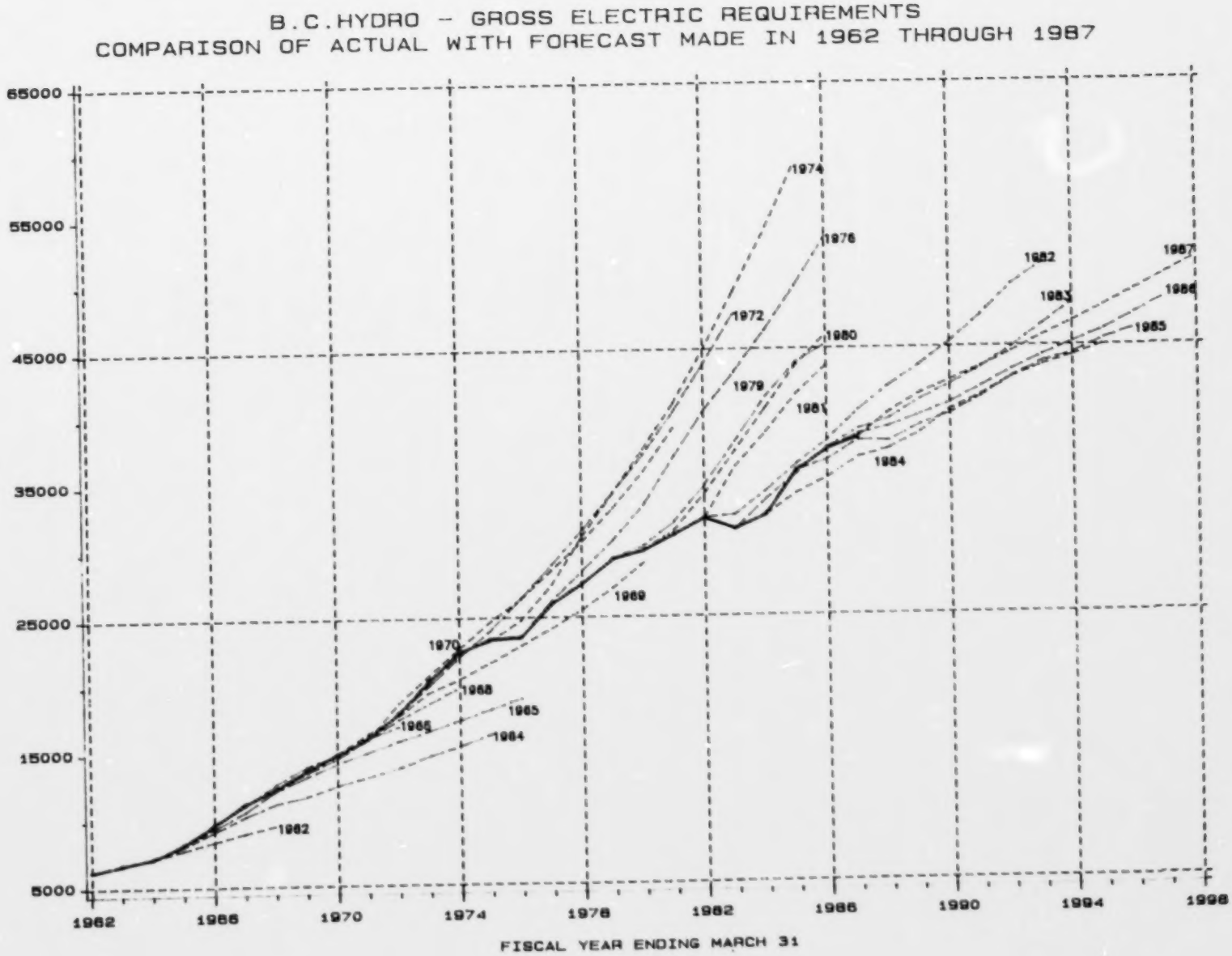
B.C.HYDRO - GROSS ELECTRIC REQUIREMENTS
COMPARISON OF ACTUAL WITH FORECAST MADE IN 1962 THROUGH 1987
GROSS REQUIREMENTS (GW.h)
65000
55000
45000
35000
25000
15000
5000
1962
1966
1970
1974
1978
1982
1986
1990
1994
1998
FISCAL YEAR ENDING MARCH 31
1962
1964
1965
1966
1968
1969
1970
1972
1974
1976
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987

Figure 4-3

SECTION 5.0 - MARKETING AND DEMAND SIDE MANAGEMENT

There are three sets of programs encompassed under Marketing and Demand Side Management. The Firm Industrial Marketing Programs were initiated to market surplus electricity domestically and allow domestic industry, with reduced electricity rates, to be more competitive (or in some cases to remain operational). The Interruptible Electric Marketing Programs (called Electric Plus) have recently been introduced to provide reduced rates to domestic customers by marketing a portion of the secondary energy that is generally available with a hydro generation system. The Demand Side Management (DSM) Programs are intended to reduce load through enhanced conservation programs and thus allowing (primarily) for deferrals of future generation projects and avoidance of outside purchases.

Load for the Firm Industrial Marketing Programs is included in the industrial sector forecast. For system planning this is adequate but for revenue estimates it is necessary to separate the Marketing load as they carry different rates. The programs are briefly described below.

The Interruptible Marketing Programs could have a considerable impact on the B.C. Hydro system. A major portion of the potential load is electric heating which has a low annual load factor. Thus while the energy sales may not be large, the peak demand additions to given areas of the system may be significant. It is only through actual sales and monitoring that the impact can be ascertained. However, being interruptible the intent is to minimize effects on the system by installing appropriate interrupting hardware to allow for peak load control. For the 1987 forecast the load has been treated as an add-on for planning purposes. Actual load development and possible program changes require that handling in the forecast be reviewed annually.

Demand Side Management is stressed by B.C. Hydro as a means of deferring capital expenditures and thus reducing revenue and cash flow requirements. This will entail the development of additional programs by Energy Management and require the close involvement of the Load Forecast Department to ensure consistency of the programs with the forecast. As a joint tool of Forecasting and Energy Management, enhanced modelling capability in the commercial and residential areas will be required. In this year's planning cycle, the DSM programs are being treated by Generation Planning as load subtraction. Incorporation of the DSM programs will be reviewed in future to determine the most appropriate way of handling them.

5.1 INDUSTRIAL MARKETING PROGRAMS

There are presently three programs under which electricity sales are occurring. Refer to Table 5-1.

Table 5-1

FIRM INDUSTRIAL MARKETING PROGRAMS

Fiscal Year	Block Recovery (Rate 1843) (GW.h)	Turbine Turndown (Rate 1843) (GW.h)	Industrial Rate Discount Act-Bill 28 (Rate 1845) (GW.h)	Critical Industries Act-Bill 31 (Rate 1846) (GW.h)	Total Industrial Marketing (GW.h)
1983/84 Actual	190	0	0	0	190
1983/84 Actual	387	59	0	0	446
1983/84 Actual	121	557	184	148	1,010
1983/84 Actual	0	622	335	586	1,543
FORECAST					
1987/88	0	500	293	713	1,506
1988/89	0	500	262	620	1,382
1989/90	0	0	233	477	710
1990/91	0	0	157	208	365
1991/92	0	0	33	0	33
1992/93 Through.. 1997/98	0	0	0	0	0

Turbine Turndown - (Rate 1844) is to allow purchased electricity to replace the customer's own generation from heavy fuel oil or wood waste/heavy fuel oil. Sales are to pulp and paper mills in the non-natural gas areas, Vancouver Island primarily.

The Rate is presently scheduled through March of 1988 but this forecast assumes a further 1-year extension through fiscal 1988/89. Sales are projected at 500 GW.h annually.

Industrial Electricity Rate Discount Act - Bill 28 (Rate 1845) involves rates and sales volumes negotiated on an individual customer basis and for varying lengths of time. The Act is mainly intended to promote increased production, expansion and new industry. Sales are primarily to the mining and chemical industries. Recent negotiations indicate that some of the paper and allied products load now included under the Transmission Rate category will be receiving a discount rate under this Act.

Critical Industries Act - Bill 31 (Rate 1846) was a vehicle for reopening or keeping open industries in B.C. through electricity rate discounts which were part of a package of taxation, labour cost and other concessions. The contracts were negotiated on an individual basis and for varying lengths of time. No further contracts are being negotiated. Previous contracts will extend sales under this Rate through 1990/91. Sales are primarily to metal mines (Newmont, Brenda and Bell) with all three expected to close shortly after expiration of their contracts, due mainly to depletion of economic ore.

5.2 INTERRUPTIBLE MARKETING PROGRAMS (ELECTRIC PLUS)

The intent of the programs, initially launched in the summer of 1987, is to sell interruptible surplus electricity for space heating and water heating purposes (a dual fuel concept) at reduced rates. Addition of a second meter to allow separate metering of the interruptible energy is required. The programs were initially intended to utilize approximately 2000 GW.h, which is about half the interruptible energy normally available on an annual basis between critical and normal water years on B.C. Hydro's system. In years when adequate secondary energy is not available the customers would be interrupted for a period of time dependent on actual energy available.

The Residential Program (Rate Schedule 1105) involves the addition of electric heating (space or water) with maintenance of the present fuel-fired system as backup. Backup systems may be oil, propane, butane, wood or coal. In addition, existing electric heating systems may qualify for the rate with the addition of an appropriate backup system. This latter type load would have no peak impact on the B.C. Hydro system as it would be a transfer from firm to interruptible load. However, it does have the same long-term impact as strategic conservation programs by allowing the deferral of new generation.

The General Program (Rate Schedules 1205, 1206 and 1207) is intended for commercial and industrial customers and is similar to the residential program. It is available for space heating, water heating, and industrial process heating where a permanent backup heating system is maintained which uses oil, propane or a solid fuel.

The Electric Steam Boilers Program (Rate Schedule 1805) is for the use of electricity to produce steam, replacing fuel oil.

The programs are still in their infancy and no clear indication exists as to what the rate of penetration will be and what the total new load (as opposed to transfer from existing firm load) will be. For planning purposes, new sales of 450 GW.h have been assumed by 1990/91.

5.3 DEMAND SIDE MANAGEMENT PROGRAMS

Demand Side Management (DSM) refers to utility activities designed to influence customer use of energy in a way that will produce desired changes in the utility's load. Both load building and load reduction may be involved. Strategic energy conservation, which may be purchased or induced by other means such as education, is intended to reduce utility load. The reduction results from increased efficiency of energy use on the part of the customer that has been induced by the utility.

For B.C. Hydro, the benefit of load reduction programs result primarily from their impact on the timing of new generation projects and avoidance of energy purchases. This results from the energy-critical (rather than peak-critical) nature of the B.C. Hydro system. Deferral of generation projects results in reductions of both cash flow and revenue requirements.

For the 1987/88 Electric System Plan five demand side management programs were included. For the 1988/89 Electric System Plan and future System Plans, new and revised DSM programs will be reviewed for inclusion. A brief description of the presently developed programs follows.

Energy Efficient (EE) Motors encourages the use of energy efficient motors and variable speed drives in the industrial and commercial sectors. The technology will provide customers the same function, but will reduce energy requirements.

Energy Saver Lamps encourages the use of 35 watt 4-foot fluorescent lamps in place of the industry standard 40 watt units, and is focused primarily at the commercial sector. These lamps provide almost the same lighting levels with reduced energy requirements.

The Gas-Fuel of Choice program is focused at new residential (including row house and apartment) construction to reduce the number of dwellings that use electricity for space and water heating.

The Hydro Home program is designed to reduce future electric load growth by developing and promoting higher building standards for new homes that will use electricity for space and domestic hot water heating.

The Hydro Retrofit program is designed to reduce base load electric consumption by increasing the insulation in existing electrically heated homes.

The presently estimated total savings in sales for the above five programs is in the order of 800 GW.h by 1997/98 and 1,500 GW.h by 2007/08.

The DSM programs, because of their intent to be used as a probabilistic variable by generation planning in preparation of the System Plan, are not incorporated directly into the forecast. However, Load Forecast was directly involved in their development to avoid double counting conservation impacts in the forecast.

APPENDIX A

FORECAST METHODOLOGY

A.1 METHODOLOGY

The annual load forecast includes the development of short and long-term sales, energy and peak projections for B.C. Hydro. Regional details by rate category are developed for 11 years and summary level projections are developed for 21 years for use in long range planning. Also monthly details for the next fiscal year are prepared for use in revenue projections. A 10-year revenue forecast is also prepared.

The forecast is developed by residential, commercial and industrial components which are allocated to rate category components later in the process. The major economic drivers for the forecast are obtained from provincial government agencies with specific inputs on key industrial areas and energy prices from consultants.

A Load Forecast Review Committee was set up this year to provide a forum for the users of the forecast in B.C. Hydro to have input and be aware of the key factors. Meetings were held to review the key economic assumptions and then to review the draft forecast and the various components. The forecast was subsequently reviewed and approved by Management.

(a) Residential

The residential forecast is developed with the use of two models - the cohort survival model and the residential model. Starting with demographic projections of fertility, mortality and migration an age specific population forecast, by operating division (region), is developed using the cohort model. The provincial level results are compared and made to conform with the MEMPR population projection. The detailed results become one input to the residential model.

The residential model is an end-use stock model. That is, it starts with an age specific regional population projection and through projections of headship rates and dwelling preferences, develops a regional housing stock for each year of the forecast. Based on a base year load profile for each dwelling type in each region, and projections of usage trends for space heating, water heating, lighting and ten major appliances, the model develops energy sales forecasts. Also included in the model are considerations of space heating fuel choices based on fuel prices, furnace efficiencies, and gas availability; demolitions, conversions, and retrofitting of housing stock; and penetrations and life cycles of various appliances.

Also, an elaborate procedure exists for developing projections of short-term (3-year) account additions from the operating personnel in the field. Starting at the District level, Residential heating and non-heating (plus General under 35 kW and General, 35 kW and over) category customers are summated to the Division level. These numbers are compared to the results based on the long-term methodology and via review meetings between Load Forecast and Divisional staff, short-term customer numbers are determined. The customer numbers become the basis for providing Divisional energy projections for distribution planning purposes.

The historical energy data that is essential to the forecast analysis is maintained by the Load Forecast Department. It is used in part for the weather normalization procedure which provides adjusted use data for the base year load profile.

(b) Commercial

The commercial forecast is developed from an analysis of the five main components (by Standard Industrial Classification - SIC). For each component the sectoral GDP projection is analyzed to determine the portion of GDP that may be attributable to growth in stock. Stock growth is then related to various building floor-space components and this is combined with load profiles and projections of energy use for the various types of floorspace. The health and education categories are projected separately using models that utilize age specific components of the population.

The ICA (Industrial Consumption Analysis) System is essential to the load analysis in the commercial sector. B.C. Hydro customers are coded by SIC in the ICA system allowing load data to be analyzed and projected consistent with the categorization of the sectoral economic drivers.

(c) Industrial

The industrial forecast is based on detailed analysis of each sector (SIC). For the areas of greatest significance, such as forestry and mining, world market perspectives are obtained from consultants. Production levels are analyzed in relation to provincial sectoral GDP forecasts. Patterns in energy intensity are considered in relation to technological change. Specific customer information is obtained and utilized to mold the short-term projections relative to the macro industry outlook.

The forecast is prepared on a customer specific basis for the large transmission rate accounts.

The ICA system is also essential to load analysis in the industrial sector.

A.2 INPUTS TO THE FORECAST

The following list defines the major inputs and sources of information that drive the forecasts:

(a) Residential

- Migration and total population forecasts are obtained from Central Statistics Bureau (B.C.) in the Ministry of Economic Development (MED).
- Historic fertility, mortality, migration, migrant age profile, and census population are obtained from Statistics Canada.
- Historic headship rates and dwelling preference are obtained from Statistics Canada.
- B.C. Hydro accounts by dwelling type and by region are obtained from the Electrical Operations (Customer Services) Group.
- Demolition and conversion data come from the Commercial Activity Report (CAR) generated by Electrical Operations.
- Four-year account projections are developed in the field and cumulated by Electrical Operations.
- Historic account and total energy use information is obtained from the Load Forecast Information System (LFIS) - adjusted billing statistics.
- Degree day statistics are obtained from the Residential and Commercial Energy Management Department (R&CEM).
- Base year load profiles are developed using the Residential End-Use Survey - 1984 for appliance saturations and Energy Management data sheets specifying estimated consumption rates for appliances.
- Projections of trends in energy consumption for appliances come from Residential and Commercial Energy Management.
- Comparative information on appliance saturations and use trends are obtained from other utilities through the Canadian Electrical Association (CEA) and the Electric Power Research Institute (EPRI) in the U.S.
- Space heating capture rates are available from Electrical Operations.

- Furnace efficiencies are determined from information from Residential and Commercial Energy Management.

- Energy price projections are developed with assistance from consultants.

(b) Commercial

- Sectoral GDP projections come from the Ministry of Economic Development.

- Historical sales data is from LFIS and from the ICA System.

- Building stock growth comes from real estate surveys and from CanData, a data series providing actual construction starts by building type.

- Load profiles are developed from Residential and Commercial Energy Management data and from other utility data.

- Use patterns for various building types are obtained from a customer data base maintained by Residential and Commercial Energy Management.

- Forecast use trends are developed from specific application trends given by Residential and Commercial Energy Management.

- Health care statistics are obtained from provincial agencies.

- School data and trends in area per student are obtained from the Ministry of Education.

(c) Industrial

- Sectoral GDP projections come from Ministry of Economic Development.

- Key industry (electric intensive) world outlooks are obtained from consultants.

- Historic consumption data comes from LFIS/ICA and the Customer Information Control System (CICS).

- Short-term projections (1 to 5 years) are based on consultation with all major customers through the Transmission Supply Marketing Department.

- Energy use trends are obtained from recent studies, consultant inputs and historical trends.

- Reviews of the key sectors of the projections are solicited from provincial government agencies, consultants and other organizations.

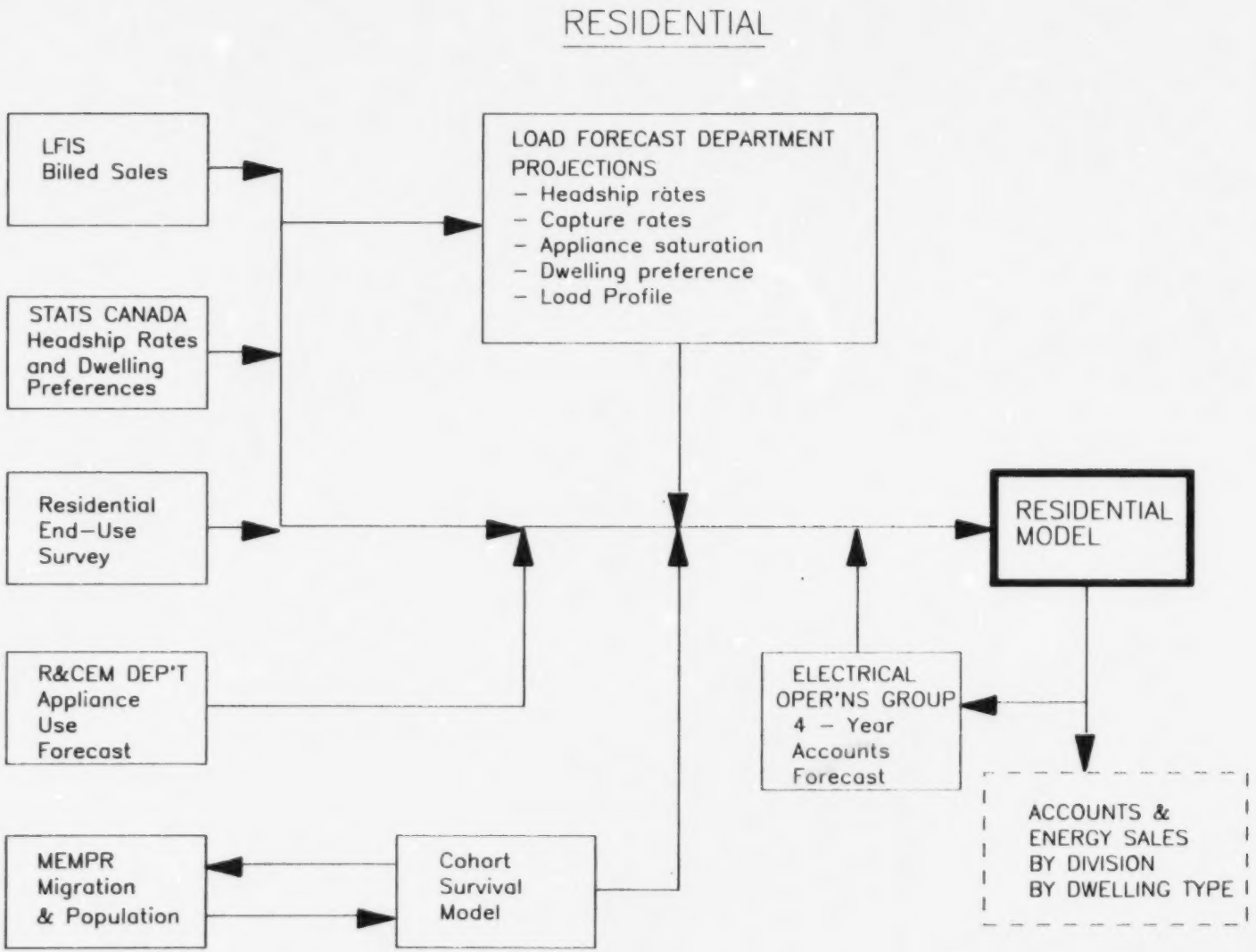
RESIDENTIAL
LFIS
Billed Sales
STATS CANADA
Headship Rates
and Dwelling
Preferences
Residential
End–Use
Survey
R&CEM DEP'T
Appliance
Use
Forecast
MEMPR
Migration
& Population
Cohort
Survival
Model
LOAD FORECAST DEPARTMENT
PROJECTIONS
– Headship rates
– Capture rates
– Appliance saturation
– Dwelling preference
– Load Profile
RESIDENTIAL
MODEL
ELECTRICAL
OPER'NS GROUP
4 – Year
Accounts
Forecast
ACCOUNTS &
ENERGY SALES
BY DIVISION
BY DWELLING TYPE

Figure A–1

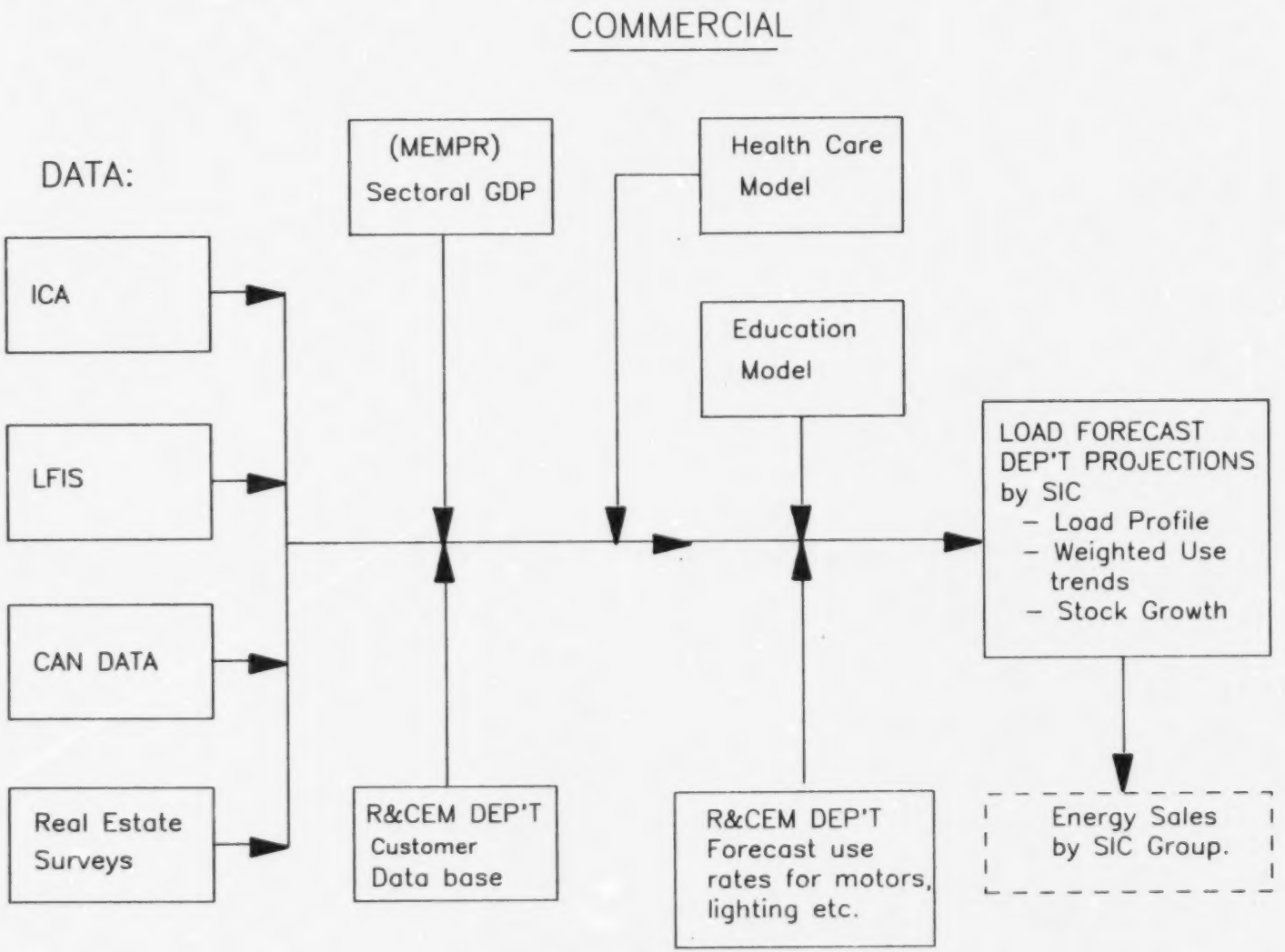
COMMERCIAL
DATA:
ICA
LFIS
CAN DATA
Real Estate Surveys
(MEMPR) Sectoral GDP
Health Care Model
Education Model
R&CEM DEP'T Customer Data base
R&CEM DEP'T Forecast use rates for motors, lighting etc.
LOAD FORECAST DEP'T PROJECTIONS by SIC
– Load Profile
– Weighted Use trends
– Stock Growth
Energy Sales by SIC Group.

Figure A–2

APPENDIX B
RATE CATEGORIES

The forecast, as described in the body of this document, is developed along homogenous sectors, i.e. residential, commercial and industrial. For most planning purposes and revenue projections, however, it is necessary to transcribe the probable (base) forecast into the rate categories.

A discussion of the rate categories and how they are estimated follows:

Residential - This category equates directly to the residential sector forecast and thus requires no translation.

General, Under 35 kW - This category encompasses mainly small commercial customers, e.g. the "corner store", and thus is contained largely in the commercial sector forecast. Customers are related to total General and Residential customers. Usage rates are based on historical trends. Customers, usage rates and thus total sales are compared with the total General category (i.e. including General, 35 kW and Over).

General, 35 kW and Over - This category contains larger commercial and smaller industrial customers. The projections are done concurrently with the General, Under 35 kW category, for customers, usage rates and total sales, for consistency. As well, plans for transfer of larger customers to the Transmission Rate category are considered.

Transmission Rate - Included here are customers that have a demand of 5 MW or larger. These customers (78 at the end of 1986/87) are mainly the larger industrial accounts such as pulp and paper mills, mines and chemical plants. Also included are refineries, some of the larger wood manufacturing facilities and some of the larger commercial customers such as U.B.C., grain and other bulk loading terminals. Projections in the short term are based on customer inputs and in the longer term are related to industry outlooks and projections.

Irrigation, Street Lighting and B.C. Hydro Own Use - These are small specific rate categories that are assumed to all be within the commercial sector.

Firm Industrial (Domestic) Marketing Programs - These loads are within the industrial sector and are primarily dealt with on an individual customer basis.

Table B-1 provides historical data and the forecast through 1997/98 by rate categories.

For relating the commercial and industrial sales to the major rate categories refer to Tables 3-3 and 3-5.

Table B-1

B.C. HYDRO HISTORICAL AND PROBABLE ELECTRIC SALES FORECAST BY RATE CATEGORIES
(Billed Sales, No Adjustment For Accrual)

Fiscal Year	Resident. (GW.h)	-- General -- Under 35 kW (GW.h)	35 kW & Over (GW.h)	Trans. Rate (GW.h)	Irrig-ation (GW.h)	St. Light. (GW.h)	BCH own Use (GW.h)	Dom. Mktg. (c) (GW.h)	Firm Exp. + Inter-Util. (a) (GW.h)	Total Billed Sales (GW.h)
HISTORICAL										
1976/77	6,625	2,021	5,571	8,166	27	192	125		197	22,924
1977/78	7,051	2,101	5,972	8,479	39	191	127		204	24,164
1978/79	7,492	2,159	6,353	9,133	35	198	132		218	25,720
1979/80	7,727	2,213	6,736	9,217	50	206	142		227	26,518
1980/81	8,042	2,226	7,118	9,597	41	220	89		231	27,564
1981/82	8,640	2,328	7,378	9,339 (b)	41	224	98		260	28,308
1982/83	8,821	2,301	7,403	9,046	47	228	99		261	28,206
1983/84	9,005	2,251	7,578	9,074 (b)	49	226	85	190	262	28,720
1984/85	9,577	2,423	7,917	10,498	56	230	89	446	267	31,503
1985/86	9,793	2,494	8,343	10,650	68	238	89	1,010	452	33,137
1986/87	9,666	2,426	8,546	11,134	57	239	81	1,543	622	34,314
Avg. Annual Growth: % 10 years:										
76/77-86/87	3.8%	1.8%	4.4%	3.1%	7.8%	2.2%	-4.2%	-	12.2%	4.1%
FORECAST										
1987/88	10,105	2,566	8,654	11,645	59	242	81	1,506	679	35,537
1988/89	10,314	2,656	8,759	12,610	62	246	83	1,382	668	36,780
1989/90	10,531	2,738	9,031	13,600	63	250	84	710	636	37,643
1990/91	10,751	2,824	9,334	14,190	67	254	86	365	648	38,519
1991/92	10,976	2,923	9,651	14,795	70	258	88	33	661	39,454
1992/93	11,215	3,021	10,006	15,150	72	263	89		674	40,490
1993/94	11,459	3,124	10,336	15,385	75	269	91		689	41,428
1994/95	11,722	3,237	10,681	15,665	78	274	93		705	42,456
1995/96	11,994	3,355	11,042	15,925	81	280	95		724	43,495
1996/97	12,263	3,479	11,412	16,150	83	286	96		744	44,513
1997/98	12,522	3,610	11,792	16,415	85	292	98		764	45,578
Avg. Annual Growth: % 11 years:										
86/87-97/98	2.4%	3.7%	3.0%	3.6%	3.7%	1.8%	1.7%	-	1.9%	2.6%

(a) "Firm Export & Inter-Utility" column includes: New Westminster, Point Roberts, Out of Province (Alberta), Seattle City Light and W.K.P.& L.

(b) Forest industry labour disruptions in 1981/82 and 1983/84 caused reductions in Transmission Rate sales.

(c) Firm Domestic Marketing Programs are detailed in Table 5-1.

APPENDIX C

USE OF FORECASTS IN SYSTEM PLANNING

System Planning utilizes the load forecast in preparing the development plans for the distribution, transmission and generation systems. This appendix describes the various formats of the peak demand forecast(s) prepared for the annual planning functions and how consistency between the various uses is ensured.

C.1 DISTRIBUTION SUBSTATION FORECASTS[1]

Load Forecast provides (see Appendix A for derivation) a 10-year energy sales forecast to Distribution Technical Services. This is a forecast of distribution sales (residential, general, irrigation, street lighting, B.C. Hydro own use, marketing and demand side management) for each of the next 10 years by operating division.

Distribution Technical Services uses the distribution sales forecast to prepare Divisional (peak) demand forecasts and provide allowable variances in peak forecasts from the sales forecast. The variance guideline is drawn from the historical correlation of actual annual Divisional demand and actual energy sales over the past 10-year period. The average annual demand growth has paralleled the energy growth over this period with a variance of 1 year in 10 or better for each Division, except Vancouver Island which has been 1 year in 7.5. Acceptable lower and upper ranges for the additive substation peak demand average annual growth rates by Division are provided to the Divisional Engineering Departments.

The Divisional Engineering Departments assign load growth to the various distribution substations in their Division so that the overall annual growth in Divisional demand satisfies the guideline.

The distribution substation forecasts are used in distribution and transmission planning.

---

1 Refer to manual, Distribution Planning Practice, Section 2, for further details.

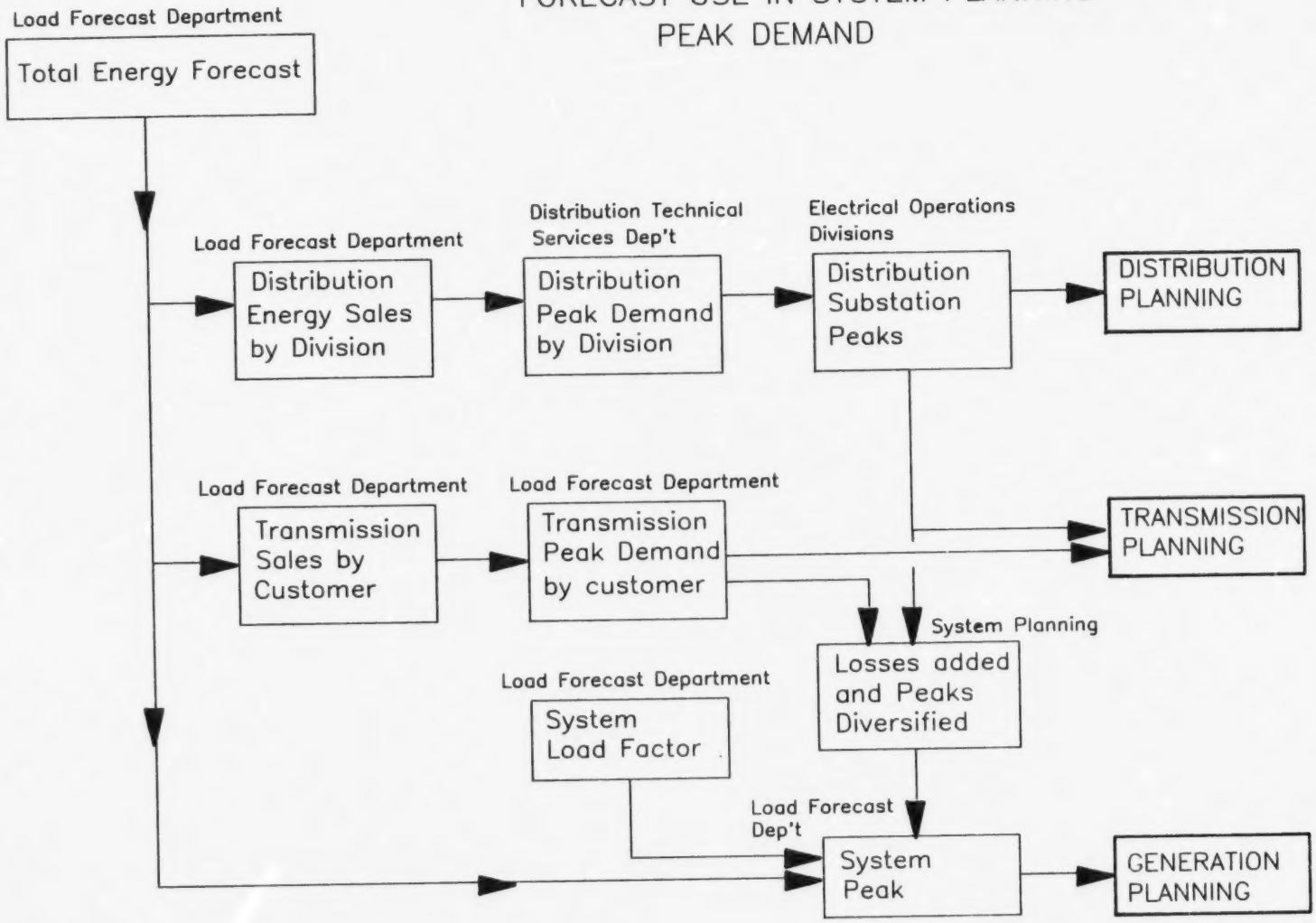
FORECAST USE IN SYSTEM PLANNING
PEAK DEMAND
Load Forecast Department
Total Energy Forecast
Load Forecast Department
Distribution Energy Sales by Division
Distribution Technical Services Dep't
Distribution Peak Demand by Division
Electrical Operations Divisions
Distribution Substation Peaks
DISTRIBUTION PLANNING
Load Forecast Department
Transmission Sales by Customer
Load Forecast Department
Transmission Peak Demand by customer
TRANSMISSION PLANNING
System Planning
Losses added and Peaks Diversified
Load Forecast Department
System Load Factor
Load Forecast Dep't
System Peak
GENERATION PLANNING

Figure C-1

C.2 CUSTOMERS SERVED AT TRANSMISSION VOLTAGES

The majority of these customers are in the Transmission Rate category. There are some customers (generally less than 5 MW size and for special circumstances), however, that are served at a transmission voltage (defined in this instance as 60 kV or higher) and fall in the General Rate Category. These transmission customers are treated separately for planning purposes.

Load Forecast provides peak demand forecasts for all transmission voltage customers. Peaks are generally based on the individual sales projections.

The transmission voltage customer peak forecasts are used along with distribution substation forecasts for transmission planning.

C.3 SYSTEM PEAK FORECAST[2]

Load Forecast provides, based on the total energy forecast, a system peak projection at the generation level.

This forecast is used in generation planning and as a check in transmission planning. The additive peaks of distribution substation and transmission voltage customer with losses added are diversified, using historical relationships, and checked against the calculated system peak. Thus a "closed loop" ensures consistency in all levels of peak forecasts being used.

---

2 See Section 3.0 for details on calculation.